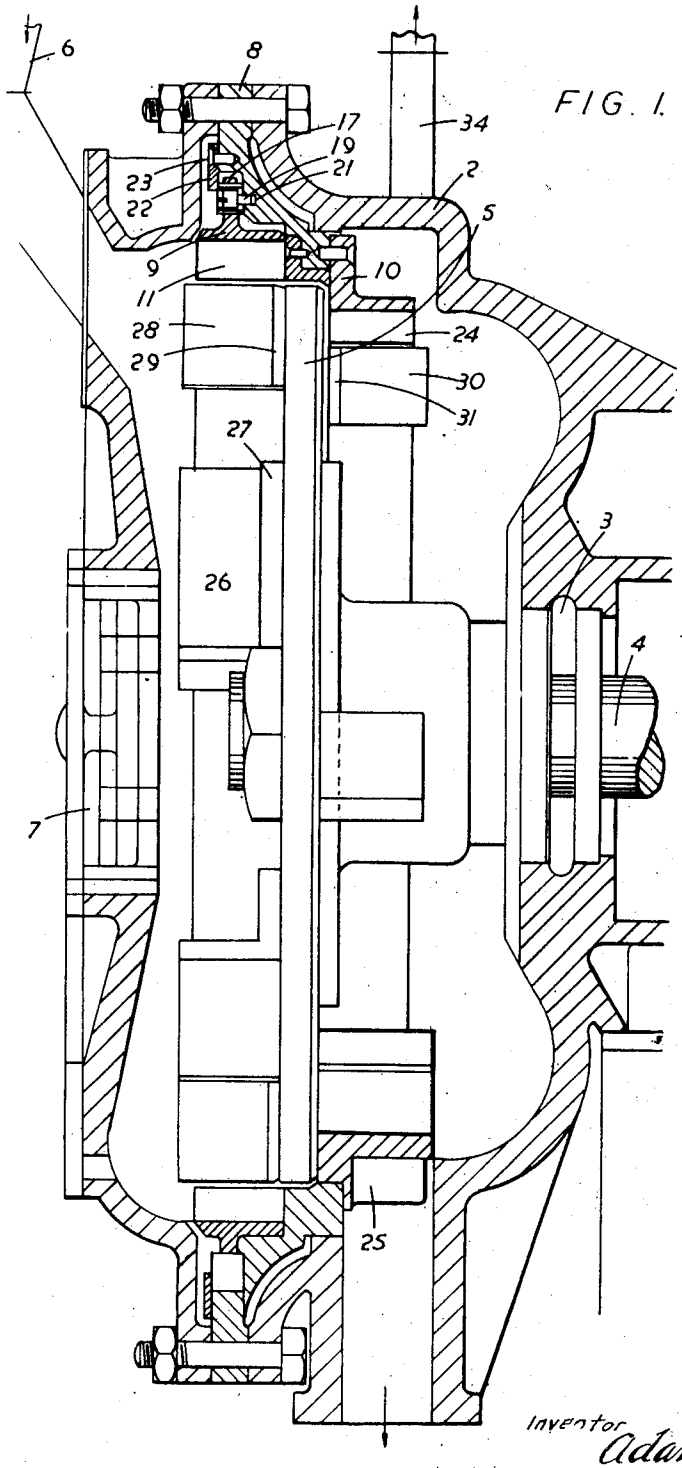
Oct. 28, 1952 A. BITTNER 2,615,637

CYCLONE DISINTEGRATOR

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FIG. 1.



Inventor
Adam Bittner
By
Thiess, Olsen & Mecklenburg
Attorneys.

Oct. 28, 1952 A. BITTNER 2,615,637

CYCLONE DISINTEGRATOR

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FIG. 2.

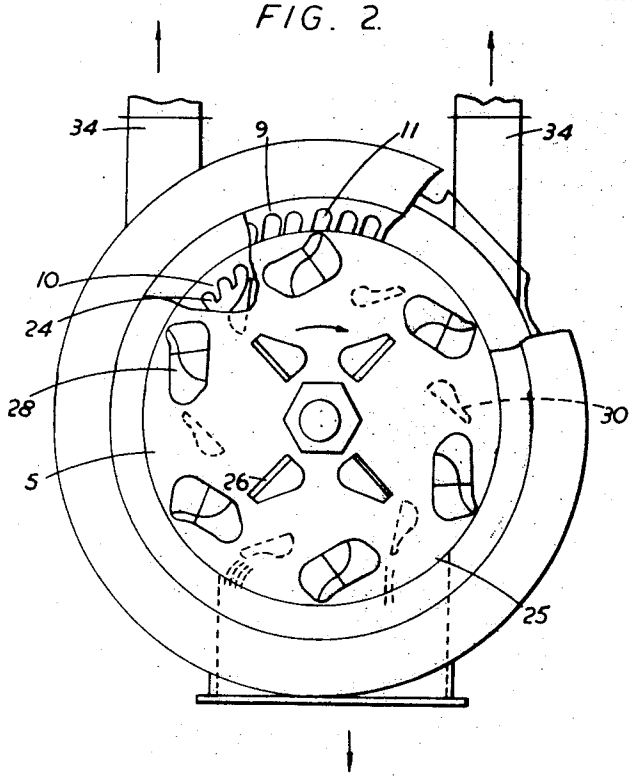
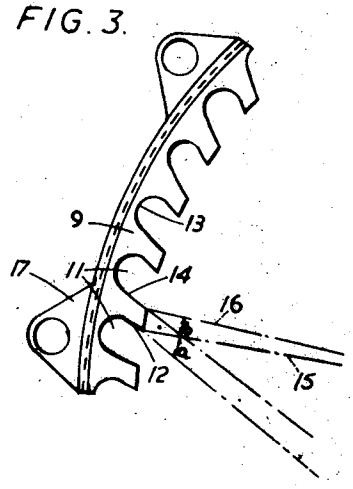


FIG. 3.



Inventor
Adam Bittner.
By Thiess, Olsen & Mecklenburger.
Attorneys.

Oct. 28, 1952 A. BITTNER 2,615,637

CYCLONE DISINTEGRATOR.

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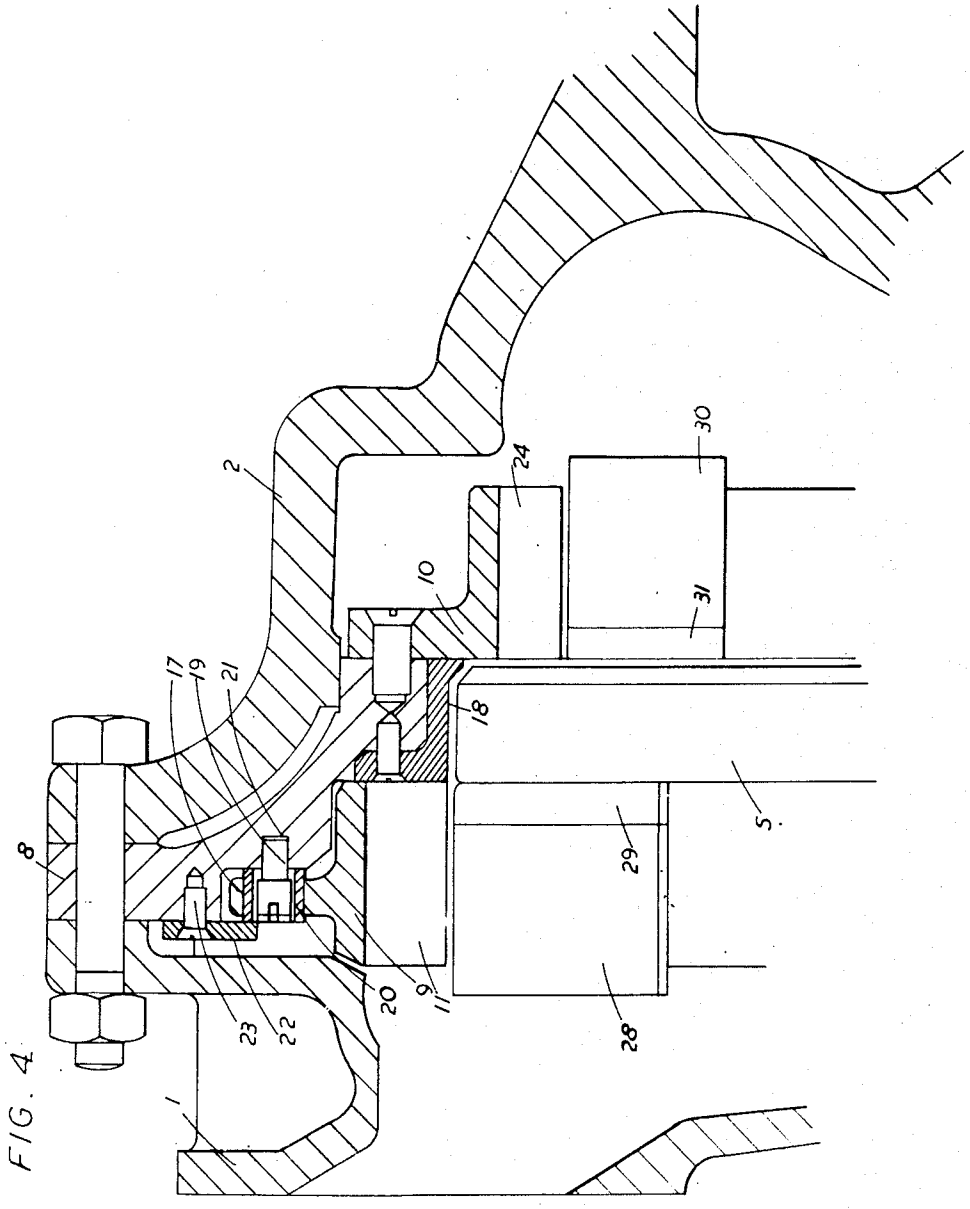


FIG. 4

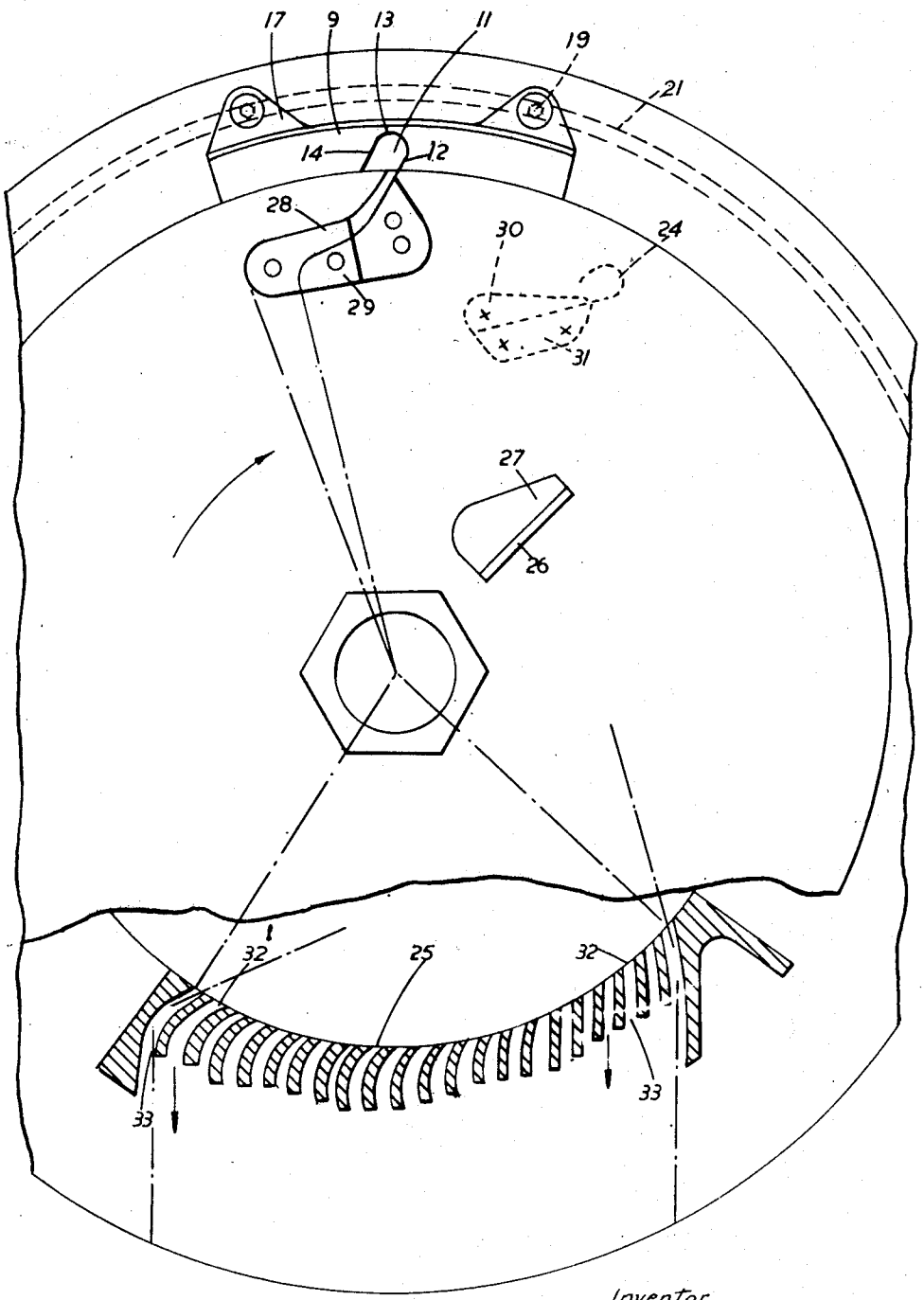
Inventor
Adam Bittner.
by: Thies, Olson & Mecklenburger
Attorneys

Oct. 28, 1952 A. BITTNER 2,615,637

CYCLONE DISINTEGRATOR

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FIG. 5.



Inventor
Adam Bittner
By.
Theiss, Olson & Merkenbrager.
Attorneys.

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UNITED STATES PATENT OFFICE

2,615,637

CYCLONE DISINTEGRATOR

Adam Bittner, London, England, assignor to Cyclomat Dominion Corporation Limited, Douglas, Isle of Man, a company of Isle of Man

Application September 20, 1950, Serial No. 185,785
In Great Britain November 24, 1949

12 Claims. (Cl. 241—39)

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This invention relates to improvements in or relating to disintegrating apparatus of the kind in which a rotor provided with vanes revolves within a peripheral stator provided with pockets, and in which material fed into the apparatus in discrete particles is thrown by centrifugal force into and is whirled around within the pockets to form eddies, whereby it is disintegrated by shock, attrition and inter-particular friction.

It is a disadvantage of known machines of this kind that the power consumption is unduly high.

It has been found according to this invention that the eddies or whirling motion of air and entrained material within the pockets may be modified to give better disintegration with lower power consumption by the use of guide vanes which are bounded front and rear by surfaces which change direction as they extend outwards, i. e. away from the rotor axis, the surfaces having an inner portion, tangential to a radius drawn from the rotor axis, merging in a smooth curve with an outer portion inclined at substantially the same angle as the entry faces of the pockets.

Accordingly the present invention provides a disintegrating apparatus comprising a rotor rotatable within a peripheral stator, an annular set of pockets in the stator, the pockets being inclined forwards in the direction of rotation of the rotor, and a set of guide vanes mounted on the rotor adjacent its periphery to guide material into the pockets, the vanes being bounded front and rear by surfaces which change direction as they extend outwards, i. e. away from the rotor axis, the surfaces having an inner portion, tangential to a radius drawn from the rotor axis, merging in a smooth curve with an outer portion inclined at substantially the same angle as the entry faces of the pockets.

The inclination of any part referred to above is to be understood herein as referring to the angle made by that part with a radius drawn from the axis of the rotor.

References herein to "disintegrating" are to be understood as including any process by which the particle size of the material under treatment is reduced, such as milling, grinding, pulverizing, reducing defibrinating or decorticating. The apparatus of the invention may be used for treating either hard or soft materials, including minerals, ores, stone, coal, cereals and wood pulp. As is later explained, the relationships between the different parts of the apparatus should be chosen according to the nature of the material and the treatment to which it is to be subjected.

Preferably the rear surface of each vane, as it

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passes outwards, first diverges away from and then converges towards the front surface.

It will be understood that the front and rear surfaces of the vanes face respectively forwards and rearwards in the direction of rotation of the rotor.

According to a further feature of the present invention a disintegrating apparatus comprises a rotor rotatable within a peripheral stator, an annular set of pockets in the stator, the pockets being inclined forwards in the direction of rotation of the rotor, and a set of guide vanes mounted on the rotor adjacent its periphery to guide material into the pockets, has a stator housing provided with a discharge grid extending over a lower segment of the stator housing peripherally of the rotor, the grid having discharge passages with entry portions all inclined forward in the direction of rotation of the rotor to substantially the same degree and with exit portions all extending substantially vertically downwards.

The discharge grid tends to eliminate eddies in the disintegrated material discharged from the apparatus, and the elimination of such eddies leads to a reduction in the power consumption of the apparatus.

One embodiment of the invention will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a vertical longitudinal section through the disintegrating apparatus,

Fig. 2 is a front view on a reduced scale partly broken away,

Fig. 3 is a detail front view showing a segment of the first stator crown,

Fig. 4 is an enlarged detail of Fig. 1, and

Fig. 5 is a partly-sectioned diagrammatic front view.

Referring now to Figs. 1 and 2 of the drawings, the apparatus has a stator housing consisting of front and rear shells 1 and 2. The rear shell 2 contains a bearing 3 within which a shaft 4 carrying a disc 5 rotates clockwise as viewed in Figure 2. The disc 5 is adjustable along the shaft 4. A hopper 6 serves to introduce material through the upper part of the front shell 1, and an extra air inlet 7 provided with regulating means, not shown, is provided in the centre of the front shell 1. A flanged supporting ring 8 is interposed between the front and rear shells 1 and 2 and the latter are bolted together. Stator crowns 9 and 10 are secured to the front and rear sides of the supporting ring 8. The front shell 1 is suitably shaped to assist material, entering by the hopper 6, to pass to the stator crown 9. The sta-

tor crown 9 is composed of eight separate segments (Fig. 3) each provided with pockets or recesses 11 which are open on three sides, namely on the inner side and to the front and rear. Each pocket 11 is bounded by a straight entry face 12, a cylindrical portion 13 and a straight exit face 14. Each entry face 12 makes with a radius 15 drawn to it from the centre of the rotor axis an acute angle *a* larger than the acute angle *b* made by the exit face 13 with a radius 16 drawn from the rotor axis. The segments of the stator crown 9 are provided with apertured lugs 17. The segments in the assembled position bear against a bushing 18 (Fig. 4) seated on an internal shoulder of the flanged supporting ring 8. The segments are locked by pins 19 floating in bushes 20 in the apertured lugs 17, the pins 19 entering an annular groove 21 formed in the supporting ring 8. The segments of the stator crown 9 are retained by a locking ring 22 which engages over bushes 20 and pins 19 and is releasably secured by set screws 23 to the supporting ring 8. In order to equalise wear on the different segments of the stator crown 9, the screws 23 may from time to time be slackened to enable the stator crown 9 to be turned round a little, whereafter the screws 23 are again tightened up.

The second stator crown 10 (Figs. 2, 4 and 5) is of a diameter three-quarters of that of the stator crown 9. The stator crown 10 is made up of a number of segments containing pockets 24 and of a lower segment 25 in the form of a grid, which will be described later. The segments of the second stator crown 10 are bolted direct to the rear of the supporting ring 8. The pockets 24 are similar but not identical in configuration with the pockets 11, and are scaled down to some three-quarters the size of the pockets 11.

A number of beaters (Fig. 5) is mounted on the front face of the disc 5 intermediate the centre and the periphery. The beaters are in the form of angle plates having vanes 26 normal to the surface of the disc having flanges 27 bolted to the disc. The vanes 26 extend radially of the disc. A plurality of guide vanes are also mounted on the front face of the disc adjacent the periphery and consist of profiled vanes 28 having flanges 29 bolted to the disc. The front face of a vane 28 is constituted by a surface which initially extends radially from the axis of the rotor, then extends outwards substantially tangential to a radius drawn from the rotor axis and finally changes direction in a smooth curve to end in an outer portion which is inclined at substantially the same angle to a radius drawn from the rotor axis as is the entry face 12 of a pocket 11. The front face is normal to the plane of the disc.

The rear face of a vane 28 consists of an inner portion, tangential to a radius drawn from the rotor axis, merging in a smooth curve with an outer portion which is also inclined to a radius drawn from the rotor axis at substantially the same angle as is the entry face 12 of the pocket 11. As may be seen the rear surface of a vane first diverges away from and then converges towards the front surface. The inner portion of the rear surface of a vane is in the form of a parabolic curve. The rear surface may be either normal or inclined to the plane of the rotor disc.

The rear face of the disc 5 is provided adjacent its periphery with profiled guide vanes 30 having a flange 31 bolted to the disc. The rear surface of the guide vane 30 is similar in profile to the rear surface of the guide vane 28 but is scaled down to three-quarter size. The front face of the guide vanes 30 is plane and is inclined to a radius drawn from the rotor axis of the same angle as is the entry face of the pockets 24.

The segmental grid 25 is provided with passages in the form of slots extending across the width of the grid. Each slot or passage has an entry portion 32, each entry portion making the same angle with a radius drawn to it from the centre of the rotor axis. The passages have exit portions 33 which are all parallel to one another and extend vertically downwards.

Up-take conduits 34 lead upwards from the rear shell 2 and are provided with filters, not shown.

In operation, material is fed in through the hopper 6 and undergoes preliminary crushing or disintegration by the beater vanes 26 and is then directed by the guide vanes 28 into the pockets 11, entering the pockets substantially parallel to the entry faces 12. The guide vanes 28, sweeping rapidly past the pockets 11, produce eddies in the pockets 11 and disintegration of material proceeds in these pockets. The shape of the rear faces of the guide vanes 28 reduces the tendency for uncontrolled eddies to form outside the pockets, and thus reduces the power consumption. From the pockets 11 the material finds its way through the gap between the disc 5 and the bushing 18 into the pockets 24 of the second stator crown 10. Eddies produced in these pockets by the action of the guide vanes 30 disintegrate the material further, and finely disintegrated material escapes upwards through the uptake conduits 34. Less finely disintegrated material is directed downwards by the rear wall of the stator housing, which is suitably shaped for the purpose, towards the grid 25. The material passes through the grid and emerges from the exit portions 33 thereof in parallel streams, and may then be subjected to further segregation.

Provision is made for varying the numbers, dimensions and relative dispositions of the various parts of the machine, and also the conditions of operation, to suit different materials under treatment. The effects which may be produced by such variations are discussed below:

The speed of revolution of the rotor may be varied. It has been found that an increase in speed of the rotor, all other things being equal, produces:

(*a*) An increase of pressure in the stator housing,

(*b*) An increase in the peripheral speed of the eddies within the pockets,

(*c*) An increase in power consumption.

The number of guide vanes 28 and 30 may be varied, for example by bolting additional vanes 28 and 30 to the disc 5 and it has been found that an increase in the number of guide vanes, all other things being equal, produces:

(*a*) An increase in the quantity of air drawn into the housing,

(*b*) An increase in the speed with which the eddies in the pockets 11 move axially of the rotor,

(*c*) An increase in the power consumption.

The number of pockets 11 and 24 may be varied, by exchanging the segmented crowns 9 and 10 for crowns containing different numbers of pockets. An increase in the number of pockets in a crown, the total volume of the pockets remaining the same and all other things being equal, produces:

(*a*) An increase in the number of eddies,

(*b*) An increase in the power consumption.

The inclination of the pockets may be varied by

exchange of the crowns 9 and 10, and it has been found that an increase in the inclination of the pockets in the direction of rotation of the rotor produces:

(a) A change in the form of the eddies,

(b) An increase in the peripheral speed of the eddies,

(c) A reduction in the speed with which the eddies move axially of the rotor,

(d) An increase in the power consumption.

The spacing between the rotor disc 5 and the second stator crown 10 may be varied by adjusting the rotor disc 5 axially along the shaft 4. A reduction in this spacing produces:

(a) A reduction in the speed with which the eddies travel through the pockets 11, parallel to the axis of the rotor,

(b) Diminution in the pressure at the outlet from the stator housing,

(c) An increase of the peripheral speed of the eddies in the pockets 11,

(d) An increase in the power consumption.

The number of passages in the grid 25 may be varied by exchanging the grid and it has been found that an increased number of passages produces:

(a) An increase of pressure at the outlet from the stator housing,

(b) A reduction in the speed with which the eddies move through the pockets parallel to the axis of the rotor,

(c) An increase in the peripheral velocity of the eddies,

(d) An increase in the power consumption.

The free surfaces of the filters, not shown, positioned in the up-take conduits 34 may be varied by exchange of these filters. A reduction in the free surfaces of the filter produces:

(a) An increase of the pressure in the housing and consequently an increase in pressure at the outlet from the machine,

(b) A reduction in the speed with which the eddies move through the pockets parallel to the rotor axis,

(c) An increase in the peripheral velocity of the eddies,

(d) An increase in the power consumption.

Variations which produce an increase in the peripheral velocity of the eddies and which at the same time reduce the speed with which the eddies move parallel to the rotor axis (with corresponding increase in the power consumption) give a finer reduction of the material since the material under treatment remains for a longer time under the influence of the eddies formed in the pockets.

An increase in the peripheral velocity of the eddies is always associated with an increase in the power consumption.

Experiments have shown that for any group of materials under treatment which behave substantially similarly during their disintegration by the eddies, a given fineness can be obtained by suitable variations of the working elements of the machine, but that there is always a given set of variables which give most favourable disintegration for material of this group, with a consequent minimum power consumption.

The number of vanes 28 depends on the number of pockets 11 in the crown 9 and on the fineness to which it is desired to grind the material. The number of vanes may amount to one-sixth to one-twelfth of the total number of pockets. The length of the rear surface of a vane 28, projected on to the circumference of the disc, should preferably be three times the length of the pocket 11 projected on to the same circumference.

The width of a vane 28 measured parallel to the rotor axis depends upon the depth of the pocket 11, also measured parallel to the rotor axis, and the spacing between the disc 5 and the second stator crown 10. The sum of the two latter dimensions should be less, preferably some 15% less, than the width of a vane 28.

The guide vanes may be cast or bent to shape and are mounted for ready exchange when worn out so as to limit the expenditure on special steel.

For a primary disintegration where the throughput is more important than the fineness of the disintegrated material, the rear surface of the vanes may be of a simple form similar to that of the front surface. The speed of rotation of the machine for a primary disintegration is limited and the existence of uncontrolled eddies is then of limited effect only on the power consumption. The other conditions should be as above stated.

The first stator crown may contain some 30 to 90 pockets and the depth of the crown and the pockets measured axially may be from one-fifteenth to one-tenth of the diameter of the disc 5.

As already stated the pockets consist of an entry face, a cylindrical portion and an exit face. In general the diameter of the cylindrical portion should be increased when

(a) The material is to be less finely disintegrated,

(b) The material under treatment is easily disintegrated, even by weak eddies,

(c) The material under treatment is to be defibrinated or decorticated, or

(d) The material under treatment increases in volume on disintegration.

An increase in diameter will generally be associated with decrease in the angle of inclination of the entry and exit faces.

In order to produce more violent eddies having a greater peripheral speed and a smaller speed of movement parallel to the rotor axis, for the purpose of obtaining finer disintegration, the diameter of the cylindrical portion is reduced whilst the angles of inclination of the entry and exit faces are increased.

The internal diameter of the first stator crown should always be greater than the external diameter of the disc.

The diameter of the cylindrical part of a pocket 24 of the second stator crown 10 and the angles of inclination of its entry and exit faces should be greater than those of a pocket 11 of the first stator crown 9. The internal diameter of the second stator crown 10 should always be smaller than the external diameter of the disc.

The guide vanes 30 co-operating with the pockets of the second stator crown 10 should be inclined at a greater angle than the guide vanes 28 which co-operate with the pockets 11 of the first stator crown 9. The front faces of the guide vanes 30 may either be similar in contour to the front faces of the guides vanes 28 or may be plane.

The width of the vanes 30, measured parallel to the rotor axis, should always be greater than the sum of the width of the second stator crown 10 and the spacing between the rotor disc 5 and the second stator crown 10.

The angle of inclination of the entry portion of a discharge passage 32 in the grid 25 depends on the inclination of the entry faces of the pockets

24 of the second stator crown 10 and should preferably be within or —15° of this angle.

What I claim is:

1. A disintegrating apparatus comprising a rotor; a peripheral stator, within which said rotor can rotate, having an annular set of pockets inclined forwards in the direction of rotation of said rotor; and a set of vanes for guiding material to be disintegrated into said pockets which vanes are mounted on said rotor adjacent the periphery thereof and are bounded front and rear by surfaces which change direction as they extend away from the axis of said rotor and have inner portions, substantially tangential to radii drawn from the rotor axis, merging in a smooth curve with an outer portion inclined at substantially the same angle as the entry faces of said pockets.

2. A disintegrating apparatus as claimed in claim 1 comprising guide vanes the rear surface of each of which, as it extends away from said rotor axis, first diverges away from and then converges towards the front surface.

3. A disintegrating apparatus comprising a rotor; a peripheral stator within which said rotor can rotate, said stator having an annular set of pockets which are inclined forwards in the direction of rotation of said rotor and have entry faces which are inclined at a greater angle than the exit faces; and, mounted on said rotor adjacent the periphery thereof, guide vanes bounded front and rear by surfaces which change direction as they extend outwards away from the axis of said rotor, said surfaces having inner portions, substantially tangential to radii drawn from said rotor axis, merging in a smooth curve with an outer portion inclined at substantially the same angle as said entry faces.

4. A disintegrating apparatus comprising a rotor; a peripheral stator within which said rotor can rotate, said stator having a first annular set of pockets which are inclined forwards in the direction of rotation of said rotor and have entry faces inclined at a greater angle than the exit faces, and a second annular set of similarly shaped pockets displaced axially of said rotor behind said first set; and, mounted on said rotor, a first set of guide vanes co-operating with said first set of pockets and bounded front and rear by surfaces which change direction as they extend away from the axis of said rotor, said surfaces having inner portions, substantially tangential to radii drawn from said rotor axis, merging in a smooth curve with an outer portion inclined at substantially the same angle as said entry faces, and a second set of guide vanes co-operating with said second set of pockets, at least the outer part of said second set of guide vanes being inclined forwards in the direction of rotation of said rotor at substantially the same angle as the entry faces of said second set of pockets.

5. A disintegrating apparatus comprising a rotor; a peripheral stator within which said rotor can rotate, said stator having a first annular set of pockets which are inclined forwards in the direction of rotation of said rotor and have entry faces inclined at a greater angle than the exit faces, and a second annular set of similarly shaped pockets displaced axially of said rotor behind said first set; and, mounted on said rotor, a first set of guide vanes co-operating with said first set of pockets and bounded front and rear by surfaces which change direction as they extend away from the axis of said rotor, said surfaces having inner portions, substantially tangential to radii drawn from said rotor axis, merging in a smooth curve with an outer portion inclined at substantially the same angle as said entry faces, and a second set of guide vanes of a similar shape to the first set co-operating with said second set of pockets.

6. A disintegrating apparatus as claimed in claim 5 in which the front surfaces of said second set of guide vanes are at least partially plane.

7. A disintegrating apparatus comprising a rotor disc; a stator supporting ring; a first stator crown mounted on one side of said ring and provided with a first annular set of pockets which are inclined forwards in the direction of rotation of said disc and have entry faces inclined at a greater angle than the exit faces; a second stator crown mounted on the opposite side of said ring which stator crown has an internal diameter less than that of said first stator crown and of said disc and is provided with a second annular set of pockets similar in shape to said first set; and a set of guide vanes carried on each side of said disc each one of which sets of vanes serves to guide material to be disintegrated into one of said sets of pockets, said guide vanes being bounded front and rear by surfaces which change direction as they extend away from the axis of said rotor, said surfaces having inner portions, substantially tangential to radii drawn from the axis of said disc, merging in a smooth curve with an outer portion inclined at substantially the same angle as the entry faces of said pockets.

8. A disintegrating apparatus comprising a stator housing; a shaft journalled in said housing; a rotor disc mounted on said shaft and adjustable along it; a stator supporting ring; a first stator crown exchangeably secured to one side of said ring with respect to which it can be angularly adjusted about its own axis, said stator crown having a first annular set of pockets which are inclined forwards in the direction of rotation of said disc and have entry faces inclined at a greater angle than the exit faces; a second stator crown exchangeably secured to the other side of said ring and having a second annular set of pockets similar in shape to said first set; and a set of guide vanes carried on each side of said disc each one of which sets of vanes serves to guide material to be disintegrated into one of said sets of pockets, said guide vanes being bounded front and rear by surfaces which change direction as they extend away from the axis of said rotor, said surfaces having inner portions, substantially tangential to radii drawn from the axis of said disc, merging in a smooth curve with an outer portion inclined at substantially the same angle as the entry faces of said pockets.

9. A disintegrating apparatus comprising a housing; a rotor; a peripheral stator within which said rotor can rotate which stator is provided with an annular set of pockets which are inclined forwards in the direction of rotation of said rotor; vanes mounted on said rotor adjacent to the periphery thereof for guiding material into said pockets; and a discharge grid extending over a lower segment of said housing peripherally of said rotor and provided with discharge passages having entry portions, all of which are inclined forward to substantially the same degree in the direction of said rotor, and exit portions all of which extend substantially vertically downwards.

10. A disintegrating apparatus comprising a

housing the front wall of which is provided with an air inlet and an opening for the entry of material to be disintegrated; a rotor; a peripheral stator having an annular set of pockets which are inclined forwards in the direction of rotation of said rotor; vanes mounted on said rotor adjacent the periphery thereof for guiding said material into said pockets; and, extending peripherally of a lower portion of said rotor, a discharge grid to which disintegrated material is guided by the rear wall of said housing and which is provided with discharge passages having entry portions, all of which are inclined forwards to substantially the same degree in the direction of rotation of said rotor, and exit portions all of which extend substantially vertically downwards.

11. A disintegrating apparatus comprising a housing having in its front wall an air inlet and an opening for the entry of material to be disintegrated; a rotor; a peripheral stator annularly disposed on which is a set of pockets inclined forwards in the direction of rotation of said rotor; vanes mounted on said rotor for guiding said material into said pockets which vanes are bounded front and rear by surfaces which change direction as they extend away from the axis of said rotor and have inner portions, substantially tangential to radii drawn from said rotor axis, merging in a smooth curve with an outer portion inclined at substantially the same direction as the entry faces of said pockets; and, extending over a lower segment of said housing peripherally of said rotor; a grid through which disintegrated material can be discharged said grid being provided with discharge passages having entry portions, all of which are inclined forwards to substantially the same degree in the direction of rotation of said rotor, and exit portions all of which extend downwards in a substantially vertical direction; and uptake conduits leading out of said housing above said grid for the discharge of material disintegrated to a finer degree than the material discharge through the grid.

12. A disintegrating apparatus comprising a rotor; a peripheral stator, within which said rotor can rotate, having an annular set of pockets inclined forwards in the direction of rotation of said rotor; and a set of vanes for guiding material to be disintegrated into said pockets which vanes are mounted on said rotor adjacent the periphery thereof and are each bounded at the front by a surface which initially extends radially of the axis of the rotor, then extends outwards substantially tangential to a radius drawn from said rotor axis finally merging in a smooth curve with an outer portion inclined at substantially the same angle as the entry faces of said pockets, and at the rear by a surface which has an inner portion substantially tangential to a radius drawn from said rotor axis merging in a smooth curve with an outer portion inclined at substantially the same angle as said entry faces of said pockets.

ADAM BITTNER.

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