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APPARATUS FOR CRUSHING SOLID PRODUCTS

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FIG. 1

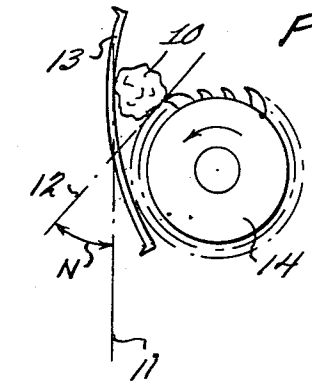
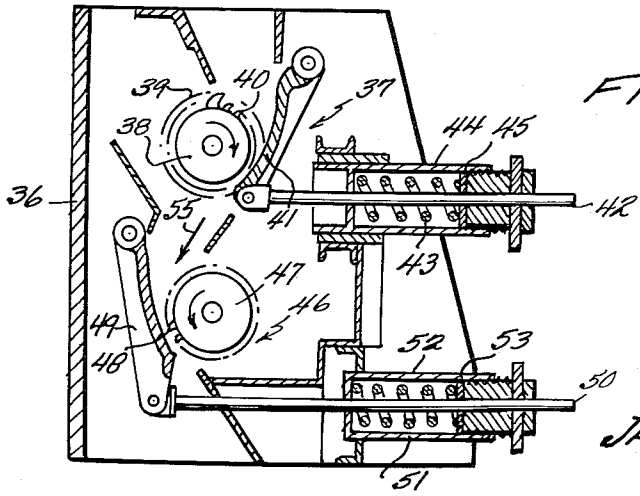


FIG. 2

FIG. 3



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APPARATUS FOR CRUSHING SOLID PRODUCTS

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This invention relates to crushing devices and has more particular reference to a process of and apparatus for crushing solid friable materials such as coal or the like.

A crusher is considered as efficient when it passes a maximum output giving a minimum of misclassified products, i.e., lumps of a greater size than the crushing mesh desired and, also, smaller sizes uselessly increasing the proportion of breakage in a plant. When there exists an excessive amount of small products it is said there is "over crushing."

At present, it is practically impossible to increase a crusher output without causing over crushing. If the rotor velocity is increased, the projection of products by centrifugal force causes an increase of breakage. In cases of a toothed ring roll, it sometimes happens that the teeth follow each other so rapidly that the crusher acts as a rasp or even as a smooth roll crusher.

While the output of a crusher can also be increased by increasing, in the case of single roll crushers, for example, the distance between the roll and the anvil plate; however, this distance increase is only possible to a small extent, as the desired crushing mesh must be respected. Furthermore, when the distance between the crushing members is increased, the risk of obtaining larger misclassified products increases, as well.

One object of the present invention is to provide a novel and improved process of and improved apparatus for crushing in which all of the foregoing objections are overcome.

Another object of the present invention is to provide a novel and improved crusher in which the rotor includes teeth of various sizes so spaced that the time required for the largest lumps to pass must not exceed the time lapse between the passage of two consecutive large teeth, so that the product is engaged between these large teeth.

Another object of the invention is to provide a crusher apparatus in which the throw of the products feeding the crusher follows a curved trajectory tangential to the bisector of the angles of seizure of the products treated, at an arrival speed at the most substantially equal to the peripheric velocity of the rotor and, at the least, substantially equal to half the peripheric velocity of the rotor so that the products pass through the crusher at a high rate without rebounding and, therefore, without over crushing.

A further object of the present invention is to provide crushing apparatus, as characterized above, employing a double deck crusher wherein two superimposed crushing devices are mounted on a single frame, the rotor of the first crusher forming the feeding device for the second crusher.

Other objects and advantages of the invention will appear in the following specification when considered in connection with the accompanying drawing, wherein:

FIG. 1 is a diagrammatic side elevational view illustrating the terminology "angle of seizure";

FIG. 2 is a diagrammatic side elevational view of a crusher constructed in accordance with the present invention; and

FIG. 3 is a diagrammatic side elevational view of a double deck crusher constructed in accordance with the present invention.

The present invention provides a novel and improved process and apparatus for crushing solid material and, in general, comprises a toothed roll and a concave anvil plate resiliently held in a predetermined position relative to the toothed roll, which is provided with teeth of various sizes so spaced that the time required for the largest lumps to pass does not exceed the time lapse between the passage of two consecutive large teeth so that the product is engaged between these large teeth; also, the device includes provision for feeding the crusher so that the products fed to the crusher follow a curved trajectory tangential to the bisectors of the angles of seizure of the products treated, at an arrival speed at the most substantially equal to the peripheric velocity of the rotor and at the least equal to half the peripheric velocity of the rotor, so that the products pass through the crusher at a high rate without rebounding and, therefore, without over crushing.

The invention further contemplates the use of a two deck crusher, each of the toothed roller and curved concave anvil plate type, with the upper crusher discharging its treated products into the lower crusher.

Referring now to the drawing, there is diagrammatically illustrated, in FIG. 1, the terminology "angle of seizure." As there shown, a lump 10 of the product to be treated (shown in spherical form for simplification) has been received in a crusher. Tangent lines 11 and 12, drawn at the point of impact of this lump with a concave plate 13 and the roll 14, respectively, intersect and produce an angle "N" called the angle of seizure of the lump 10.

In FIG. 2 there is diagrammatically illustrated a toothed roll crusher constructed in accordance with the present invention, for carrying out the process thereof. As there shown, the crusher comprises a frame 15 which supports the crusher, indicated in general at 16, and the feeding device, indicated generally at 17, for feeding the products to be treated to the crusher.

The crusher 16 is shown as comprising a toothed rotor 18, a concave anvil plate 19, and a resilient or retractible device, indicated generally at 20, for normally resiliently maintaining the concave plate 19 in a predetermined position relative to the periphery of the rotor.

The rotor 18 may be rotated at any desired speed by any suitable means (not shown) and its periphery is fitted with a plurality of circumferentially spaced axially extending rows 21 of large teeth and a plurality of axially extending rows 22 of small teeth are positioned between adjacent rows of large teeth.

The concave anvil plate 19 has an impact surface whose section resembles a logarithmic spiral portion. The upper end of the plate is pivotally mounted on an axle 23 fixedly attached to the frame 15. The lower end of the plate 19 is pivotally connected, as at 24, to the end of a rod 25 forming part of the resilient device 20.

The resilient or retractible device 20 is shown as comprising a coil spring 26 mounted in a cylinder 27 carried by the frame 15 and having a piston-like rod 25 slidably extending through the cylinder 27 and carrying a disc 28 positioned to engage the outer end of the spring 26 so that the extended spring, acting through the rod 25, normally holds the concave plate at a predetermined distance from the periphery of the toothed rotor 18.

The feeding device 17 is shown as comprising an endless flexible belt 29 extending around two drums 30, 31 and adapted to be tightened by a tightening roller 32. The drum 30 is mounted for rotation about an axle mounted in slidable bearings 33 mounted for translatory movement on a slider 34. The drums 30, 31 are rotated at desired speeds by any suitable means (not shown).

The operation of the crusher is as follows:

Once the toothed rotor 18 is rotated at the desired

speed, the speed of the endless feeder belt 29 is regulated, as well as the position of drum 30, so that the products to be crushed more or less thrown by belt 29 (following the path indicated by arrow 35) follow, owing to their kinetic energy braked by gravity, a curved trajectory tangential to the bisectors of the seizure angles of the lumps to be treated and come between the crushing parts at a speed more or less substantially equal to the peripheric velocity of the rotor and at least equal to half the peripheric velocity of the rotor, the peripheric velocity being measured at half the distance between the hub, i.e., the full part of the rotor and the concave plate 19, at the point where their spacing is least, thus insuring the products passing through the crusher at a high speed without rebounding and, therefore, without over crushing.

In FIG. 3 there is illustrated a modified form of a crushing device embodying a two deck crusher. As there shown, a single frame 36 supports two superimposed crushers. The upper or first deck crusher, indicated generally at 37, includes a rotor 38 fitted with circumferentially spaced axially extending rows of large teeth 39 and a plurality of axially extending rows 40 of smaller teeth between adjacent rows of large teeth, a curved anvil plate 41 having its upper end pivotally mounted on the frame 36 and its lower end pivotally connected to a rod 42 of a retractible device similar in construction to the retractible device 20 shown in FIG. 2, and includes a coil spring 43 mounted in a cylinder 44 carried by the frame 36 and having the piston-like rod 42 slidably extending through the cylinder and carrying a disc 45 positioned to engage the outer end of the spring 43 so that the extended spring, acting through the rod 42, normally holds the concave plate 41 at a predetermined distance from the periphery of the rotor 38.

The bottom or second deck crusher, indicated generally at 46, includes a rotor 47 fitted with circumferentially spaced axially extending rows 48 of small teeth only, a concave anvil plate 49 having its upper end pivotally mounted on the frame 36 and its lower end pivotally connected to a reciprocable rod 50 of a resilient device similar to the resilient device 20 shown in FIG. 2, and includes a coil spring 51 mounted in a cylinder 52 carried by the frame 36 and having the piston-like rod 50 slidably extending through the cylinder and carrying a disc 53 positioned to engage the outer end of the spring 51 so that the extended spring, acting through the rod 50, normally holds the concave plate 49 at a predetermined distance from the periphery of the rotor 47.

A feeding device, indicated generally at 54 and identical in construction and operation to the feeding device shown in FIG. 2, feeds the products to be crushed into the top deck crusher.

The operation of this modified form of apparatus is as follows:

The velocity of the bottom rotor 47, fixed after study of the friability of the product to be treated, will determine the velocity of the rotor 38 of the top deck, which should be adjusted in such a way that the products discharged from the top deck arrive at the bottom deck at a velocity at least substantially equal to half the peripheric velocity, such as defined above of rotor 47, and at most substantially equal to the peripheric velocity of the rotor 47. The shape of the bottom part of the concave plate 41 is designed so as to give the discharged products a curved trajectory, indicated by arrow 55, tangential to the bisectors of the angles of seizure of the lumps to be treated. In the same way, the velocity of rotation of the top rotor 38 will determined the adjustment of the feeding device.

This double deck apparatus permits a considerable reduction to be obtained, starting from any given size, while occupying a reduced space in comparison with that which would have been necessary for two crushers producing the same total production, one after the other.

This application of the invention, permitting the choice of the trajectory of arrival of the product and the choice of the rotation speed of the two rotors, by suppressing the over crushing, even when the crusher is fed with a high input, allows the first deck to be used as a "pre-crusher" and the second deck as a "granulator," whether the product treated be hard or friable. This name "granulator" implies that the product will be in the shape of grains.

Obviously, the invention is not restricted to the embodiments thereof herein shown and described.

What is claimed is:

1. A material crushing device of the character described comprising:

(*a*) a casing having a feed opening therein;

(*b*) upper and lower crusher means positioned in said casing;

(*c*) each of said crushing means including a rotor and a cooperating anvil plate with the axis of the rotors being in a substantial vertical plane, and the anvil plate of the upper crushing means being to one side of the vertical plane and the anvil plate of the lower crushing means being to the other side of the vertical plane;

(*d*) the anvil plate of the top crushing means having its upper end pivotally mounted and its lower end adjacent the rotor, and with the curvature of the plate adjacent the rotor being such that material ejected therefrom travels tangentially across the casing;

(*e*) the anvil plate of the lower crushing means having its upper end pivotally mounted in the casing above the highest point of the lower rotor to position the upper position of the anvil plate in the flow of material from the first crushing means and direct it downwardly, the lower end of the anvil plate being adjacent the lower rotor.

2. The device defined in claim 1 wherein the surface of the upper rotor is provided with a plurality of large and small teeth and the surface of the lower rotor with teeth substantially equal in number to the teeth on the upper rotor but smaller than the smaller teeth on the upper rotor.

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