July 7, 1970 T. D. DAVIS ET AL 3,519,212

CRUSHER FEEDING METHOD

Original Filed March 24, 1964

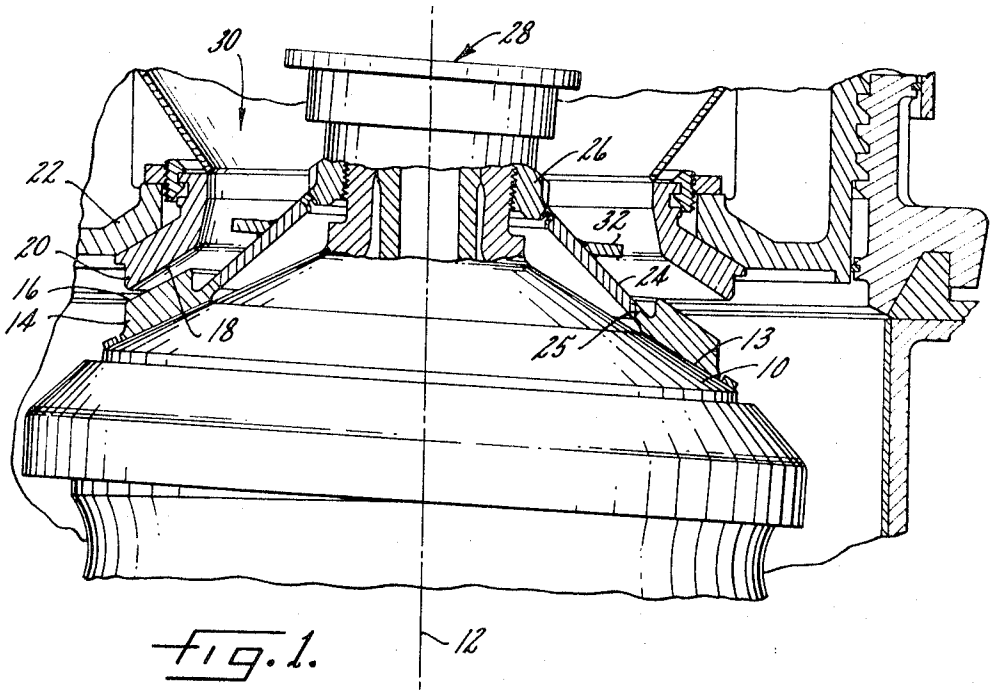


Fig. 1.

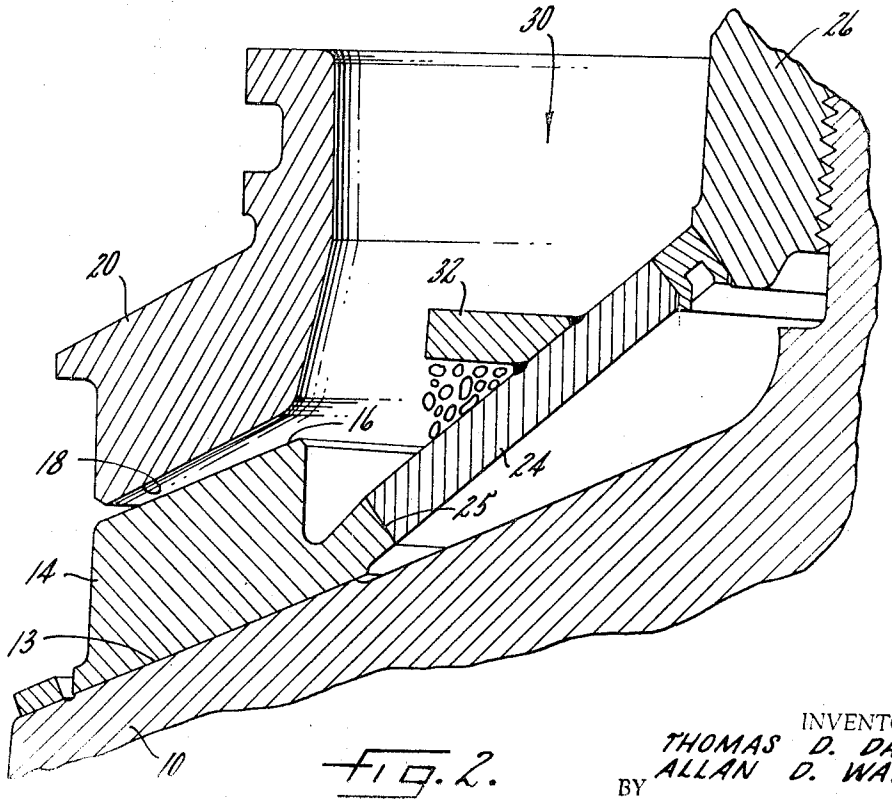


Fig. 2.

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United States Patent Office 3,519,212
Patented July 7, 1970

3,519,212

CRUSHER FEEDING METHOD

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Application Mar. 24, 1964, Ser. No. 354,216, now Patent No. 3,329,356, dated July 4, 1967, which is a continuation-in-part of application Ser. No. 232,843, Oct. 24, 1962. Divided and this application Apr. 10, 1967, Ser. No. 629,715

Int. Cl. B02c 2/04

U.S. Cl. 241—30 6 Claims

ABSTRACT OF THE DISCLOSURE

A method of operating a gyratory crusher by applying a positive congesting pressure to the material within the crushing zone as the gyrating member of the crusher is moving away from the stationary crushing member, and agitating the material above the crushing cavity as the gyrating member is moving toward the stationary member. The areas of pressure application and material agitation are diametrically opposed. A frictional force is applied to drag material into the crushing cavity as the gyrating crushing member is moving away from the stationary crushing member. The combination of positive pressure and frictional force applied to the material moves the material at a speed greater than that of gravity into the crushing zone.

This invention relates to gyratory crushers, and in particular to a method for increasing the material feed to and through a crushing cavity. This is a division of our copending application Ser. No. 354,216, filed Mar. 24, 1064, now Pat. No. 3,329,356, issued July 4, 1967, which was a continuation-in-part of Ser. No. 232,843, filed Oct. 24, 1962, now abandoned.

One purpose of the invention is a method of the type described in which a positive congesting pressure is applied to the material feed to pack the crushing cavity.

Another purpose is a method of the type described in which the material feed is driven at a velocity, greater than that caused by gravity alone, into the crushing cavity.

Another purpose is a method of operating a gyrating crusher which increases the maximum amount of product of a desired size.

Another purpose is a method of the type described in which the material above the crushing cavity is agitated or loosened to provide a free flow into the crushing cavity.

Another purpose is a method of the type described including the step of frictionally dragging material to be crushed into the crushing cavity.

Another purpose is a method of operating a gyrating crusher in which the crushing cavity is opened, above its optimum, and a downwardly directed positive pressure is applied to the material feed to increase the amount of usable product moved through the crushing cavity.

Another purpose is a method of operating a gyratory crusher by applying a positive congesting pressure to the material in the crushing cavity and agitating the material above the crushing cavity to keep it in a freely flowing condition.

Other purposes will appear in the ensuing specification, drawings and claims.

The invention is illustrated diagrammatically in the following drawings wherein:

FIG. 1 is a partial vertical section through a crusher of the type described, and

FIG. 2 is an enlarged section illustrating the crushing cavity and the means for applying a congesting pressure to the material feed.

This invention is usable for example with a crusher of the type shown in U.S. Pats. 2,670,142 and 2,917,247. The invention should not be limited to this particular type of crusher, as it may be applicable to other gyratory crushers.

Considering a crusher of the type disclosed in the above two patents, it should be noted that the crushing cavity forms a smaller angle with the horizontal than in other types of gyratory crushers. For example, the crushing cavity may form an angle of on the order of 25 to 30 degrees with the horizontal, as contrasted to an angle of about 45 degrees in other types of gyratory crushers. Crushers of this type may be used on limestone or similar materials. For each desired size of product there is an optimum setting of the crushing cavity discharge opening. As an example, if the desired product size is —⅛ inch, a crushing cavity opening of 5/16 inch might be the optimum. The size of the cavity can be increased, for example to one-half inch, and the total tonnage through the crusher will substantially increase. However, the amount of usable product will be below the amount of usable product with a 5/16-inch setting. In other words, the size of the crushing cavity can be increased, but the amount of usable product does not increase, and may fall off. There is therefore an optimum setting for the crushing cavity for each size of desired product. It should be understood that the figures given above are merely examples or illustrations, and do not necessarily apply to any particular type or size of machine.

It has been found that the capacity of a crusher for producing a desired size of product can in some cases be increased as much as 50 percent if a positive pressure is applied to the material feed to compact it and to drive it into the crushing cavity at a speed greater than its velocity from free fall. This positive pressure may be combined with a crushing cavity opening above the optimum. Merely opening the cavity above the optimum is not sufficient. The material feed must be driven into the cavity at a velocity greater than that attained merely by free fall or through gravity so that the cavity is congested and the material is packed in the cavity. Although it is preferred that the cavity be enlarged in size and the material be driven with a positive pressure, in some applications merely the use of a positive pressure is sufficient.

Considering FIG. 1, the conical head of a gyratory crusher is indicated at **10** and it will rotate and gyrate about an axis **12** as is conventional. Details of the crusher can be found in either of the above-mentioned U.S. patents. The head **10** which has an outer surface **13** that slants downwardly and outwardly and mounts a mantle **14** having an upper surface **16** that defines a crushing cavity with the lower surface **18** of a bowl liner **20**. The bowl liner is attached to the bowl **22** as is conventional. It should be noted that the angle of the crushing cavity is on the order of 25 to 30 degrees, or is much flatter than in many types of gyratory crushers. In operation, as the head and mantle gyrate, the head will move the material in the crushing cavity generally normally toward the bowl liner.

Mounted on the head above the mantle **14** is a conic thrust member or sleeve **24** which abuts the upper edge **25** of the mantle and applies a downward thrust thereto. The upper end of the thrust member **24** is held in position by a securing nut **26** which is threaded to the head. Mounted above the securing nut **26** is a feed plate assembly indicated generally at **28** which is not important to this invention. In operation, the feed plate assembly will rotate and will distribute material into the zone **30** above the crushing cavity proper.

Mounted on the thrust member **24** is an annular ring **32**, which as shown herein, is separate and welded to the thrust member. The ring may be integral with the thrust member. Either form is satisfactory. The ring **32** extends laterally into the zone **30** above the crushing cavity. It is important that the area between the outer circumferential or peripheral edge of the ring and the opposing surface of the bowl liner be no less than the area of the opening into the crushing cavity. This is necessary in order not to restrict the material flow into the crushing cavity. In operation, the head will gyrate and the mantle will move toward and away from the bowl liner. The mantle is moved toward the bowl liner in a defined zone which rapidly circumferentially moves about the crushing cavity. As the mantle moves away from the bowl liner, ring **32** will move downwardly into the mass of material and will drive it toward the crushing cavity. The ring **32** congests the material in the cavity at a greater rate than it would merely by falling through gravity. The ring **32** may accelerate movement of the material feed into the cavity at a rate approximately twice that of gravity.

In addition to the downwardly directed congesting pressure which is applied as the mantle is moving away from the bowl liner, when the mantle moves toward the bowl liner, the ring **32** will apply an upwardly directed force which will have a tendency to loosen or agitate the material in the space **30**. In certain types of material, for example limestone or the like, there may be a tendency to pack or bridge. This may be due to clay in the material, particle size and shape, moisture content, etc. It is therefore desirable to continually agitate and loosen the material so that it can freely flow into the crushing cavity. The ring **32** performs this function and maintains the material as individual particles rather than as an adhered mass of particles.

Material may be trapped beneath ring **32**, as illustrated particularly in FIG. 2, with the result that the ring and the material trapped beneath it form a generally vertical rough and uneven surface which will frictionally drag material to be crushed from the space **30** down into the crushing cavity. The height and lateral extent of ring **32** determines the extent of the vertical frictional face. In this connection, the size and position of ring **32** may vary with different materials and the size of the finished product.

The thrust member **24** is conventionally made of a steel which is abrasive resistant. There is very little impact of the material feed upon this member, but it will be subject to considerable abrasion. Accordingly, a steel which is satisfactory to resist abrasion is customarily used. The thrust member **24** is a replaceable wear part in that even though made of an abrasive-resistant steel, it will need replacement after a period of use. Accordingly, it may be desirable to form the thrust ring **24** integral with the ring **32**. For example, these two members may be cast as a single unit. The ring **32** may be separate, and welded or otherwise secured to the thrust member **24**.

The use, operation and function of the invention are as follows:

By utilizing the present invention, the capacity of a gyratory crusher may be increased as much as 50 percent, both in total tonnage and in the maximum amount of usable product. The material may be accelerated or pushed toward the crushing cavity at a speed approximately twice that of gravity. A downward congesting pressure is applied by the ring **32** to positively move the material toward the crushing zone. The material is congested or compacted so there is sufficient attrition crushing to reduce the material to size. With crushers of the type referred to above there is attraition reduction as well as impact reduction. In many gyratory crushers there is only impact. By congesting the material in the crushing cavity there is additional attrition and therefore faster reduction of the material feed. Because there is additional attrition crushing, the cavity can be opened to let more material pass through it without any reduction in the amount of usable product of a desired size. It is the combination of the downwardly applied pressure and the opening of the crushing cavity above the optimum which permits increased capacity. However, the capacity should never be increased to the point where the crusher is overloaded.

Not only does the ring perform the function of driving more material into the crushing cavity, but it has an additional function in applying an upwardly directed agitating force to keep the material in the zone above the crushing cavity free and loosely packed so that it can flow easily into the crushing zone. Also, material is dragged into the crushing cavity by the frictional force provided by the material caught beneath the ring **32**. It is the combination of all three functions that makes the ring **32** advantageous.

It should be noted that the congesting pressure will be applied to the material as the head moves away from the bowl liner. At one point around the crushing cavity the mantle or head will be moving toward the bowl liner to crush the material while on the opposite side of the cavity the head will be moving away. It is at this latter point that the downwardly applied pressure will congest the material within the cavity, to pack it for subsequent upward movement of the mantle to crush it. It should also be noted that while one side of the cavity is receiving a downwardly directed pressure to pack the material, the area above the opposite side of the cavity is receiving an upwardly directed agitating pressure or force to loosen the material so that it may freely flow into the cavity.

The invention is not practically useful with all types of material or with all crushers. As stated above, it is particularly useful with crushers which have a rather low angle for the crushing cavity, for example on the order of 25 to 30 degrees with the horizontal. A ring of this type is generally useful with particles which have an affinity for each other, preventing free flow. A crusher as described herein can be used on any material which has a very high angle of repose, for example greater than about 45 degrees. By the angle of repose it is meant the angle that a pile of material will form with the horizontal. A low angle of repose means that the particles have very little clogging or sticking tendency and the pile will tend to flatten out. A high angle of repose means that the particles have a great sticking tendency and they will not slide over each other but will tend to pyramid up. Generally speaking, coarser materials will have a high angle of repose. There will be many voids in a mass of coarse particles enabling the crushing cavity to be effectively packed.

Whereas the preferred form of the invention has been shown and described herein, it should be realized that there are many modifications, substitutions and alterations thereto within the scope of the following claims.

We claim:

1. A method of operating a gyrating crusher having a crushing zone defined by a stationary crushing member and a gyrating crusher member in which the gyrating crusher member moves material in the crushing zone generally normally towards the stationary crushing member, including the steps of applying a positive congesting pressure to the material within the crushing zone as the gyrating crushing member is moving away from the stationary crushing material, and agitating the member above the crushing cavity as the gyrating member is moving toward the stationary member.

2. The method of claim **1** further characterized in that the area of pressure application and material agitation rapidly circumferentially moves about the crushing zone, with the area of pressure application being generally diametrically opposed to the area of material agitation.

3. The method of claim **1** further characterized in that the material to be crushed is moved, by said positive pres-

sure, at an acceleration greater than that of gravity, into the crushing zone.

4. The method of claim 1 further characterized in that the application of congesting pressure includes the application of a frictional force to move material toward the crushing zone as the gyrating member moves away from the stationary crushing member.

5. A method of operating a gyrating crusher having a crushing zone defined by a stationary crushing member and a gyrating crushing member in which the gyrating crushing member moves material in a crushing zone generally normally towards the stationary crushing member, including the steps of applying a positive congesting pressure to the material within the crushing zone as the gyrating member is moving away from the stationary crushing member, with the area of pressure application rapidly circumferentially moving about the crushing zone, agitating the material above the crushing cavity as the gyrating crusher member is moving toward the stationary crushing member, with the areas of pressure application and the material agitation being diametrically opposed, and

applying a frictional force to drag material into the crushing cavity as the gyrating crushing member is moving away from the stationary crushing member, the combination of the positive pressure applied to the material as well as the frictional force applied to the material, moving the material at a speed greater than that of gravity into the crushing zone.

6. The method of claim 5 further characterized in that the material used in the crushing operation has an angle of repose greater than about 45 degrees.

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