IMPACT CRUSHER HARDENING METHOD

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ABSTRACT OF THE DISCLOSURE

A method for hardening the working surfaces of an impact type crushe: while the crushe: is in operation. Metal balls are introduction into an operating impact type crushe:, impact against the working surfaces of the crushe: and thereby harden these surfaces. If material is being crushed in the crushe:, the metal balls aid in crushing the material.

BACKGROUND OF THE INVENTION

This invention relates generally to an impact type crushe: and specifically to a method for hardening the working surfaces of the crushe: while the crushe: is in operation.

The working surfaces of most impact type crushe:s include a rotating hammer and a stationary breaker plate. The hammer and breaker plate are generally made from Hadfield manganese steel. The rotating hammer collides with material being fed into the crushe: and causes the material to be impelled against the breaker plate. This action causes the material to be broken or crushed into a number of smaller parts. In addition, this action wears away the surfaces of the Hadfield manganese steel hammer and breaker plate. In terms of hardness and ductility, Hadfield manganese steel is the most desirable material for the working surfaces. However, Hadfield manganese steel is capable of possessing the desired hardness and ductility for only a relatively small depth. Thus, after a period of time, the above wearing away of the surface of the Hadfield manganese steel exposes metal which does not possess the desired hardness and ductility. If material is crushed thereafter, the wearing away is more rapid and the possibility of breaking the hammer and breaker plate increases. As a result, impact crushe:s are generally repaired before such rapid wearing away begins. Repairs are generally made by depositing welded metal on the working surfaces to replace the metal which was worn away. However, if repairs are not made at the proper time, breakage of the hammer and breaker plate is not unusual. The replacement of broken parts and the repair of worn parts is expensive and also lowers production because the crushe: is out of operation when such repairs or replacements are being made. In addition, repairs to a crushe: may present a safety hazard. Furthermore, as the working surfaces wear, the maximum size of material discharged from the crushe: increases due to the increased distance between the rotating hammer and stationary breaker plate. Thus, the variation in size or gradation of crushe: material increases. This variation generally requires the discharged material to be subjected to additional crushing or other treatment.

SUMMARY OF THE INVENTION

It is an object of this invention to lower the cost of operating an impact crushe:.

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It is another object of this invention to facilitate the crushing of finer materials in an impact crushe:.

Still other and further objects will be apparent from the specification, claims and drawing.

The above objects can be accomplished by introducing metal balls into an impact type crushe: while it is operating. The resultant impact between the metal balls and the working surfaces of the crushe: hardens these surfaces at the desired hardness. In addition and optionally, material to be crushed may also be introduced into the crushe: along with the metal balls. In so doing, the crushe: may productively operate continually and, along with the hardening of the working surfaces, the metal balls aid in crushing the material.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a schematic side view of apparatus for practicing the invention.

FIGURE 2 is a cross sectional view of one type of impact crushe:.

FIGURE 3 is a cross sectional view of another type of impact crushe:.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIGURE 1, a steel ball storage and receiving bin 10 is positioned above and with its outlet discharging into a ball feed chute 11. The bin 10 is of sufficient capacity to store all the steel balls 12 needed in the operation hereinafter described. The ball feed chute 11 can be of any well known type which regulates the discharge of the metal balls from the chute 11 to the impact crushe: 13. For example, the chute 11 may be of a design having a labyrinth type discharge outlet. More than one bin 10 may be provided and, if desired, a different size steel ball 12 could be used for each bin 10.

With reference to FIGURE 3, when material to be crushed is not being fed to the crushe: 13a, the balls 12, after leaving chute 11 of FIGURE 1, pass through the inlet of the impact crushe: 13a and are directed into the path of the rotating hammers 14a. Hammers 14a are rotared by shaft 36a in a clockwise direction. The metal balls 12 impact against a rotating hammer 14a and are impelled by the hammer 14a against breaker plates 15a. Thereafter, the metal balls 12 fall downwardly, pass through exit opening 16a and are discharged from the crushe: 13a. Of course, due to the high rotational speed of the hammers 14a it is possible that the steel balls 12 may impact against one or more hammers 14a and breaker plates 15a a number of times before passing through the exit openings 16a.

The steel balls 12 are of such size as allows them to pass freely through the exit openings 16a. Furthermore, when the term "balls" is used, it is meant to cover a shape other than a sphere and may include a shape having one or more flat surfaces thereon. In addition, the metal balls 12 may be made from steel, alloy steel, Hadfield manganese steel or any other material having the proper hardness and ductility necessary to harden the working surfaces of the hammers and breaker plates upon impact therewith.

With reference to FIGURE 1, after leaving the crushe:, the metal balls 12 fall on horizontal conveyor 17 which moves in a direction indicated by arrow 18. Since material is not being crushed at this time, the metal balls 12 would be the only material on conveyor 17. The metal balls 12 are discharged from conveyor 17 onto sliding gate 19, which is in the lowered position as shown by dotted lines. From the sliding gate 19, the metal balls...
12 fall into chute 20 and are passed to elevator inlet 21. Thereupon, elevator 22 carries the metal balls 12 upwardly and discharges them into ball storage bin 10. Transfer of the balls 12 repeat the steps set forth above. The elevator 22 may be of any well known type which provides a means to transport the balls 12 from the discharge end of the crusher 13 to the ball storage bin 10.

In place of sliding gate 19, a magnetic pulley could be used at the discharge end of conveyor 17, or a magnetic cross belt could be used adjacent the discharge end of conveyor 17. In such a case, the pulley or cross belt would attract the balls and be arranged to discharge them onto chute 20. Of course, in such a case, the balls would be made from a material which would be attracted by a magnet.

Assuming that material is to be crushed during the hardening of the working surfaces of the hammers and breaker plates by the metal balls 12 and with reference to FIGURE 1, material 23 is fed by conveyor 24 into a primary crushe 25. The primary crushe 25 may be of any well known type. The primary crushe 25 discharges material 23 upon horizontal conveyor 17. This crushe 25 then mixes with metal balls 12 being discharged from the impact cruiser 13 and the mixture is carried by horizontal conveyor 17 and discharged onto sloping conveyor 26. Conveyor 26 moves the material in a direction indicated by arrow 27. The sliding gate 19 has been moved upwardly to the position shown by solid lines. Slowing conveyor 26 discharges the mixture of material 23a and balls 12 through a chute 28b and onto a separating means 29. This separating means 29 may be of any well known type, for example, a vibrating screen or shaker bars. If a vibrating screen is used, the balls 12 aid in preventing particles of material from binding the screen. The smaller material 23b passes through the screen into chute 30, onto conveyor 31 and into storage bin 32. The larger material 23c and the metal balls 12 pass over the separating means 29 and onto sloping conveyor 33 which moves the mixture of material 23c and balls 12 in a direction indicated by arrow 34 and discharges the mixture into the impact cruiser 13.

As shown in FIGURE 2, the mixture of larger material 23c and the metal balls 12 pass through the inlet of the crushe 34 which is directed into the path of the hammers 14 which are rotated by a shaft 36 in a counter clockwise direction. This mixture impacts against the rotating hammers 14 and is impelled by the hammers 14 against the breaker plate 15. Thereafter, the metal balls 12 and the crushing material fall downwardly and are discharged from the crushe 34 through exit openings 16. The metal balls 12 and material 23c may impact against one or more hammers 14 and breaker plates 15 a number of times. The metal balls 12 when fed into the crushe 13 along with material 23c to be crushed will collide with material 23c within the crushe 34 and aid in crushing the material. The metal balls 12 are of a size as to allow them to pass freely through exit openings 16.

The impact crushers shown in FIGURES 2 and 3 are of a type well known in the art. The crushe hammers 14 of FIGURE 2 rotate in a direction as indicated by arrow 35, while the hammers 14a of the crushe FIGURE 3 may rotate in either direction as shown by arrows 35a. The rotational speed and radius of rotation of the hammers in most impact crushers is such as to cause the hammers to move at a speed of approximately ten to twelve thousand feet per minute. This speed is sufficient to produce the proper impacting of metal balls against the hammers and breaker plates so that the proper hardening of these members can be attained. However, an auxiliary drive means (not shown) could be used to increase or decrease the rotational speed of the crushe if so desired.

The number of metal balls 12 required in the above process is a function of the amount of material being fed to the crushe, the length of the path the balls travel outside the crushe, and the time required to travel this length. In addition, the number of balls would be required where a fairly abrasive material is being crushed. Furthermore, when a less abrasive material is being crushed, it is possible that the balls could be introduced into the crushe for only a short period of time. However, for Hardfied manganese steel and most other steels, an excess of number of impacts by the balls with the working surfaces will not be detrimental. It will be apparent to persons skilled in the art that the specific arrangement of conveyors, chutes, screens, bins, magnetic head pulleys, magnetic cross belt, and crushers disclosed is by way of example only. Numerous other arrangements can be provided and one or more of the elements disclosed could be eliminated or elements added to the arrangement.

The term "hammers" includes any rotating member of a crushe having a working surface which impacts against the material being fed to the crushe. The term "breaker plate" includes any stationary member of a crushe having a working surface to which material is impelled by the hammers.

Although I have described my invention hereinabove in considerable detail, I do not wish to be limited narrowly to the exact and specific particulars disclosed, but I may also use such substitutes, modifications, or equivalents as are included within the scope and spirit of the invention or pointed out in the appended claims.

I claim:

1. A method of hardening the rotating hammers and stationary breaker plates of an impact crushe during the operation of said crushe comprising:
(a) introducing metal balls into the path of rotation of said hammers,
(b) impelling said balls against said hammers,
(c) impelling said balls from said hammers and against said breaker plates, and
(d) discharging said balls from said crushe.

2. The method described in claim 1, including introducing material to be crushed into the path of rotation of said hammers and discharging said material from said crushe.

3. The method described in claim 1 wherein said balls are of a size adapted to freely pass through the exit openings of said crushe.

4. The method described in claim 1 wherein said hammers and said breaker plates are made of Hardfeld manganese steel.

5. The method described in claim 1 wherein said balls are of a size adapted to freely pass through the exit openings of said crushe.

6. The method described in claim 2 wherein said balls are of a size adapted to freely pass through the exit openings of said crushe along with said material.

7. The method described in claim 2 wherein said balls are of a size adapted to freely pass through the exit openings of said crushe along with said material.

8. The method described in claim 2 wherein said balls are of a size adapted to freely pass through the exit openings of said crushe along with said material.

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