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IMPACT CRUSHER HARDENING METHOD

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ABSTRACT OF THE DISCLOSURE

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

BACKGROUND OF THE INVENTION

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

The working surfaces of most impact type crushers 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 crusher 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 crushers are generally repaired before such rapid wearing away begins. Repairs are generally made by depositing weld 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 crusher is out of operation when such repairs or replacements are being made. In addition, repairs to a crusher may present a safety hazard. Furthermore, as the working surfaces wear, the maximum size of material discharged from the crusher increases due to the increased distance between the rotating hammer and stationary breaker plate. Thus, the variation in size or gradation of crusher material increases. This variation generally requires the discharged material to be subjected to additional crushing or other treatment.

The above problems are intensified when the end product of the impact crusher is a relatively fine material, as today's market is demanding. The problem is intensified because of the longer crushing times required for such finer material, and the greater contact area required between the working surfaces of the crusher and the material being crushed to produce such finer material.

SUMMARY OF THE INVENTION

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

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

It is still another object of this invention to reduce a wearing away of the working surfaces of an impact crusher.

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 crusher while it is operating. The resultant impact between the metal balls and the working surfaces of the crusher retains these surfaces at the desired hardness. In addition and optionally, material to be crushed may also be introduced into the crusher along with the metal balls. In so doing, the crusher 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 crusher.

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

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 **12** from the chute **11** into the impact crusher **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 crusher **13***a*, the balls **12**, after leaving chute **11** of FIGURE 1, pass through the inlet of the impact crusher **13***a* and are directed into the path of the rotating hammers **14***a*. Hammers **14***a* are rotated by shaft **36***a* in a clockwise direction. The metal balls **12** impact against a rotating hammer **14***a* and are impelled by the hammer **14***a* against breaker plates **15***a*. Thereafter, the metal balls **12** fall downwardly, pass through exit opening **16***a* and are discharged from the crusher **13***a*. Of course, due to the high rotational speed of the hammers **14***a* it is possible that the steel balls **12** may impact against one or more hammers **14***a* and breaker plates **15***a* a number of times before passing through the exit openings **16***a*.

The steel balls **12** are of such size as allows them to pass freely through the exit opening **16***a*. 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 crusher, 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. Thereafter 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 crusher 25. The primary crusher 25 may be of any well known type. The primary crusher 25 discharges crushed material 23*a* onto horizontal conveyor 17. This crusher material 23*a* then mixes with metal balls 12 being discharged from the impact crusher 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. Sloping conveyor 26 discharges the mixture of material 23*a* and balls 12 through a chute 28 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 23*b* passes through the screen into chute 30, onto conveyor 31 and into a storage bin 32. The larger material 23*c* and the metal balls 12 pass over the separating means 29 and onto sloping conveyor 33 which moves the mixture of material 23*c* and balls 12 in a direction indicated by arrow 34 and discharges the mixture into the impact crusher 13.

As shown in FIGURE 2, the mixture of larger material 23*c* and the metal balls 12 pass through the inlet of the crusher 13 and are directed into the path of the hammers 14 which are rotated by a shaft 36 in a counter clockwise direction This mixtures 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 crushed material fall downwardly and are discharged from the crusher through exit openings 16. The metal balls 12 and material 23*c* may impact against one or more hammers 14 and breaker plates 15 a number of times. The metal balls 12 when fed into the crusher 13 along with material 23*c* to be crushed will collide with material 23*c* within the crusher 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 crusher hammers 14 of FIGURE 2 rotate in a direction as indicated by arrow 35, while the hammers 14*a* of the crusher of FIGURE 3 may rotate in either direction as shown by arrows 35*a*. 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 crusher 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 crusher, the length of the path the balls travel outside the crusher, and the time required to travel this length. In addition, more 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 crusher for only a short period of time. However, for Hadfield 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 crusher having a working surface which impacts against the material being fed to the crusher. The term "breaker plates" includes any stationary member of a crusher 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 crusher during the operation of said crusher comprising:
   (a) introducing metal balls into the path of rotation of said hammers,
   (b) impacting said balls against said hammers,
   (c) impelling said balls from said hammers and against said breaker plates, and
   (d) discharging said balls from said crusher.

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 crusher.

3. The method described in claim 1 wherein said balls after being discharged from said crusher are reintroduced into the path of rotation of said hammers.

4. The method described in claim 1 wherein said hammers and said breaker plates are made of Hadfield 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 crusher.

6. The method described in claim 2 wherein said balls after being discharged from said crusher are reintroduced into the path of rotation of said hammers.

7. The method described in claim 2 wherein said balls and a portion of said material after being discharged from said crusher are reintroduced into the path of rotation of said hammers.

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

References Cited

UNITED STATES PATENTS

755,132	3/1904	Henkel	241—25
2,165,946	7/1939	Smith	241—25 X
2,381,413	8/1945	Wolff	241—25 X
3,199,171	8/1965	Hellmann.	

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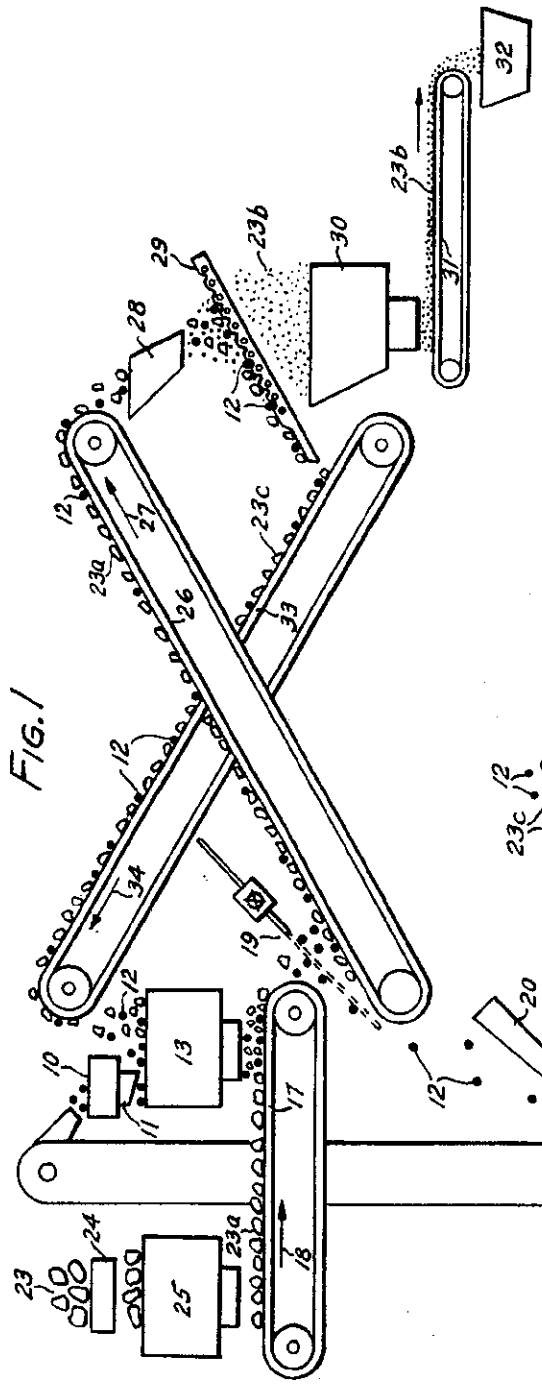

FIG. 1

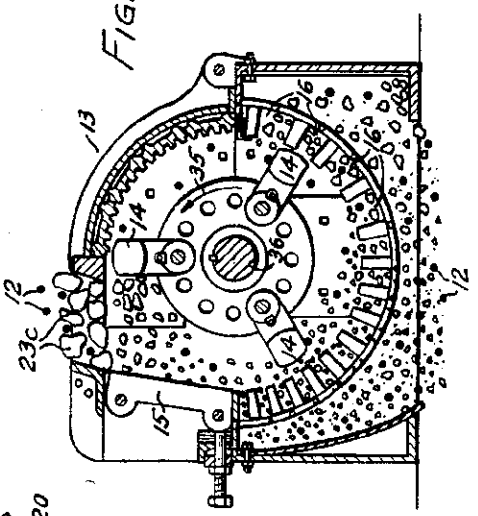

FIG. 2

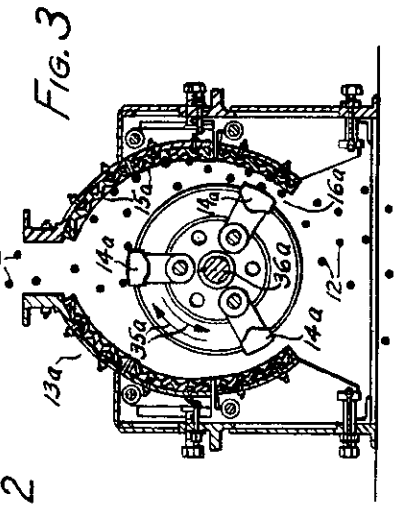

FIG. 3

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