United States Patent

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[73] Assignee Stoody Company

[54] GYRATORY CRUSHER MANTLE-BOWL STRUCTURE

6 Claims, 3 Drawing Figs.

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[50] Field of Search 241/207—216, 293—295, 299, 300

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ABSTRACT: Particularly formed telescopically mating conical elements (mantle and bowl) are disclosed for use in a cone type gyratory crusher as employed for reducing hard rock ore. Each of the conical elements includes a substantial crushing section of essentially linear taper, which has a hard metal surface layer (over 12 percent chromium and over 2.5 percent carbon) of at least 7/16-inch thickness. The two mating hard surfaces of the crusher elements (in offset concentric relationship) define an open truncated cone therebetween of variably gyrating thickness, the limits of which are substantially uniform. Above the open truncated cone, the mating elements define an enlarged, open feeding throat from which ore or other solid pieces are fed for crushing by the gyrating motion of the interior mantle element against the exterior bowl element. The relatively thick hard metal surface layers in cooperation with the linear shape of the conical crushing passage provides extended use periods for the crusher (wear being primarily abrasive) and effective crushing production.

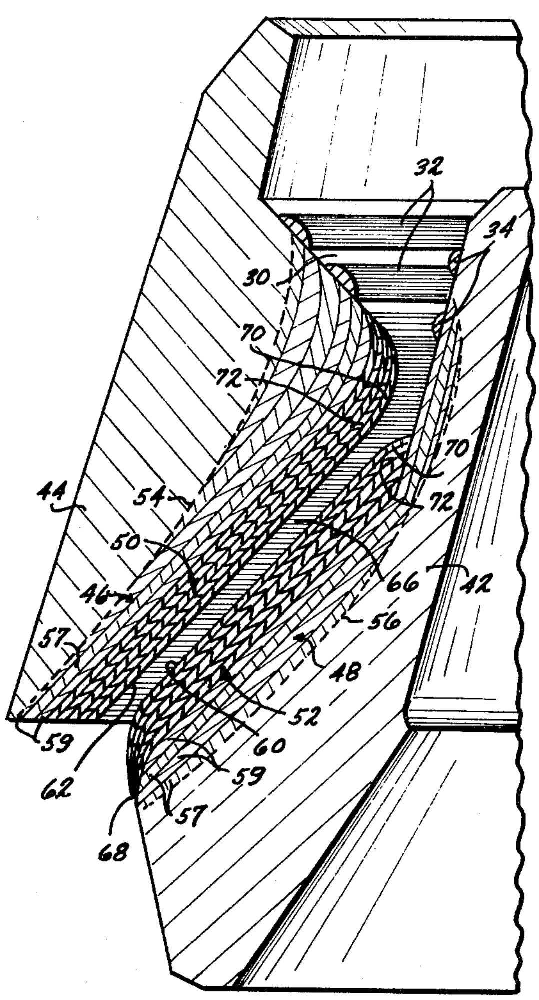

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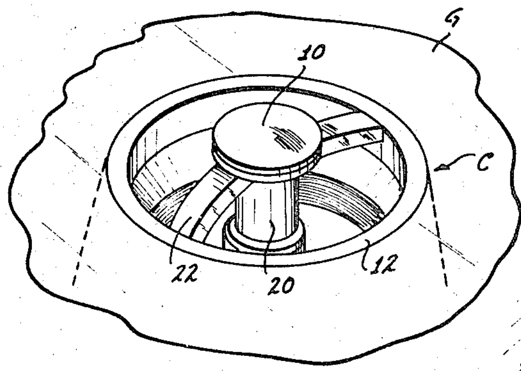
FIG. 1



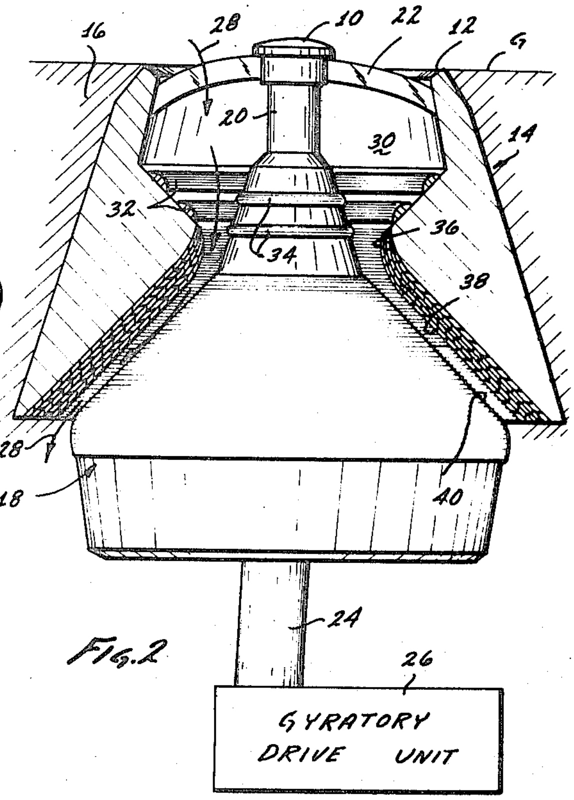


FIG. 2

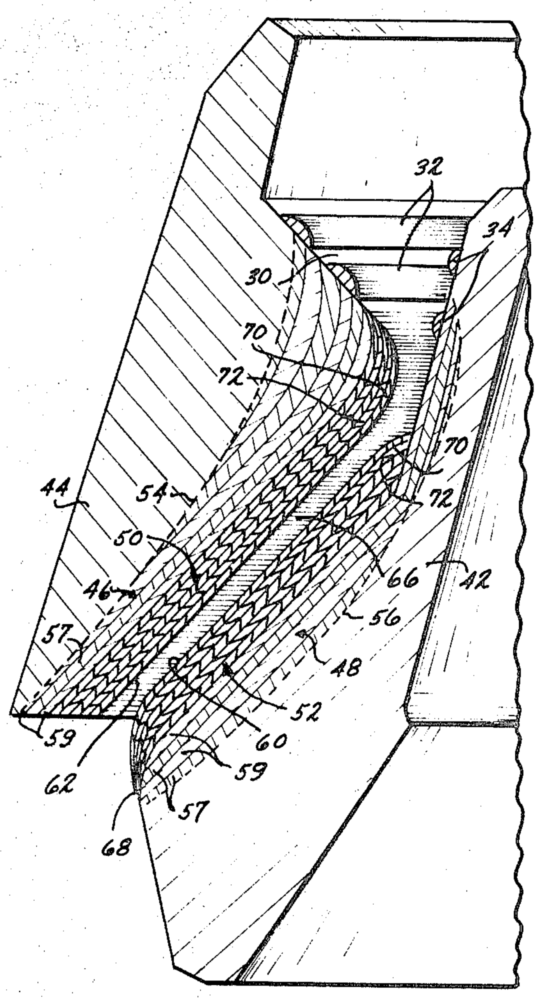


FIG. 3

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GYRATORY CRUSHER MANTLE-BOWL STRUCTURE

BACKGROUND AND SUMMARY OF THE INVENTION

Gyratory crushers are in widespread use, particularly to pulverize hard rock ore prior to refining. In one common form, these crushers conventionally comprise a mantle of modified conical shape which is telescopically received within a mating bowl. The mantle is driven in a gyrating pattern within the bowl so that ore (or the like) is crushed in passing through the opening-and-closing annular space between these elements. Somewhat conventionally, the crusher elements are made of Hadfield's Austinetic manganese alloys and are therefore quite expensive. As a result, various structural forms have been proposed in the past with the objective of accomplishing a longer duty cycle before replacement is necessary. Specifically, for example, one common structure utilizes a bell-shape curve at the lower portion of the mantle (so that it flares outward from a regular conical shape) and a mating bowl.

Although the tonnage production capability of crushers with such shapes has been a matter of some question, the use of hard facing so as to reduce wear of the units has conventionally been resolved in the negative. That is, the destructive forces within a gyratory crusher having a nonlinear taper, in the past have normally been considered to be impact forces. As a result, hard facing at best has been restricted to thin layers in order to avoid the spalling which is attendant impact forces. However, in accordance herewith, the provision of a substantially true conical space between the crusher elements, results in destructive forces which are mostly abrasive, and, which therefore can be resisted by a thick layer of hard facing on the crusher elements. Specifically, in accordance herewith, it has been determined that by providing a layer of at least seven-sixteenths inch of hard metal on the crushing surfaces of truly conical elements, major wear being primarily from abrasive forces is well resisted.

Furthermore, as another consideration, it has been discovered that by providing a substantially conical crushing space between the mantle and the bowl or bowl liner structure, a large, effective feeding throat may be provided so that wear in the conical section can be effectively adjusted without loss of production, by simply raising the mantle with reference to the mating bowl.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawing, which constitutes a part of this specification, an exemplary embodiment demonstrating various objectives and features hereof is set forth, specifically:

FIG. 1 is a perspective view of a gyratory crusher viewed in an operating location;

FIG. 2 is a sectional and diagrammatic view taken vertically through the structure as shown in FIG. 1;

FIG. 3 is an enlarged fragmentary view of the structure of FIG. 2 further sectionalized to illustrate the detailed component structure.

DESCRIPTION OF THE ILLUSTRATIVE EMBODIMENT

Referring initially to FIG. 1, there is shown a cone or gyratory crusher C set into the ground G as such structures are commonly placed for reducing hard rock ores preliminary to further processing. Ore, or the like, is simply poured into the opening between the center hub 10 and the rim 12 to pass through the crusher, emerging from the bottom in a reduced fine particle form. As better shown in FIG. 2, the rim 12 actually comprises the upper annular edge of a bowl 14 which is set in a supporting structure 16 (as merely generally represented) so that trucks are provided access to dump ore into the crusher at the top from the level of the ground G.

The mating crushing element for the bowl 14 comprises a mantle 18 which may be variously mounted as well known in the art so as to be telescopically received within the bowl 14. The mantle is supported at its upper end by an axial shaft 20 which is supportably received in the hub 10 affixed to the bowl 12 by brackets 22. The hub 10 incorporates bearing structure as well known, to accommodate gyratory motion by the mantle 18.

At its lower end, the mantle 18 receives an offset or eccentric shaft 24 which connects the mantle 18 to a gyratory drive unit 26. Various forms of this structure are widely employed which will drive the mantle 18 so that it is moved in a somewhat orbital pattern crushing the ore as it falls through a somewhat annular channel indicated by the dashed arrow 28. It is to be noted, that in FIG. 2 the mantle 18 is shown centered or concentric with respect to the bowl 14. However, it is to be understood that the motion of the mantle 18 is gyratory, and the depicted relationship of the components is merely one transitory state.

Ore supplied to the annular passage between the mantle 18 and the bowl 14, is initially received in a "feeding" throat 30 in the form of an enlarged annular cavity downwardly tapered inwardly to meet the crushing space. In the throat 30 the mantle 32 carries annular hard metal ridges 32 while the mantle 18 carries similar ridges 34. These ridges tend to protect the base metal casting comprising the bowl 14 and the mantle 18, form the destructive forces of large pieces of received ore.

Generally, the throat 30 in the bowl 14 converges to a small section 36 then diverges over a portion 38 of substantially linear outward taper. A portion 40 on the mantle 18 tapers outwardly in a substantially linear manner to mate with the portion 38 in opposing relationship. That is, both the portions 38 and 40 define an annular surface of substantially uniform linear taper and the two surfaces are in matingly facing relationship. The shapes of these crushing members (defining the passage therebetween, all cross sections of which extend in a single dimension) are a significant aspect of the present invention, in cooperation with the layers of hard metal on the portions 38 and 40. The detailed aspects of this structure will now be considered with reference to FIG. 3 to indicate the manner in which the system affords reduced wear as well as increased production.

The shape of conventional prior conical crusher elements resulting from wear and/or production is illustrated in FIG. 3 by basic castings for the mantle 42 and the bowl 44. As illustrated these elements are shown to include sections 46 and 48 respectively, of buildup metal as well as hard metal sections 50 and 52 respectively. The manner in which such additional sections are applied and the component material thereof will be considered in detail below. However, preliminarily, consider the crusher as having the somewhat arcuate sectional surfaces of the mantle 42 and the bowl 44 as defined by the lines 54 and 56 respectively.

As suggested above, it has been urged that by providing a bell shape for the mantle (indicated by the line 56) wear in the crusher is reduced. However, in accordance herewith it has been determined that by eliminating such a bell shape to provide a linear or straight conical passage as in the form of truncated right circular cone, in conjunction with a hard facing surface of substantial thickness, wear is reduced and production is significantly increased. Furthermore, it is to be noted that the conventional method of compensating for wear by moving the mantle 42 upward with reference to the bowl 44 resulted in a problem with nonlinearly flared elements. That is, as shown in FIG. 3, if the mantle 42 is moved upwardly with reference to the bowl 44 (assuming these members are formed as indicated by the lines 54 and 56) it may be seen that the operative crushing surfaces become of smaller and smaller area and the throat 38 is capable of accommodating less volume inhibiting choke-feeding operation. As a result, the efficiency of the apparatus is significantly reduced.

As indicated above, the mantle and bowl may be formed or worn to figures of revolution which are defined in section as indicated by the dashed lines 54 and 56. In applying the present invention to reform or construct such units the portions 46 and 48 are initially added by the application of weld metal, utilizing well-known arc welding apparatus. It has been found desirable to provide the portions 46 and 48 by the deposition of alternate layers **57** of nickel manganese alloy and layers **59** of carbon-chrome steel. The utilization of the alternate material layers **57** and **59** on both the bowl and the mantle has been found desirable to provide a firm base for the nickel manganese alloy and to allow the latter to work harden during actual use of the structure.

Of course, any of a wide variety of techniques may be employed to deposite the metal of the portions **46** and **48**; however, in practice applications in layers of some 5/32-inch diameter have been found very successful. In this regard, application has been accomplished by rotating the metal-receiving member in a holder as metal is deposited in a continuous bead about the circumferential surface. Submerged arc techniques have been found to be well suited for this purpose.

On completion of the portions **46** and **48**, additional metal is applied to form the sections **50** and **52** which comprise hard metal defining a passage **66** through the crusher. In this regard, it is to be noted that the surface **60** of the section **52** and the surface **62** of the section **50** lie in circular contact relationship. That is, these surfaces **60** and **62** mate as concentric right circular cones, the mating tapers of each being substantially linear. It is also to be noted that the sections **50** and **52** are builtup to provide an increased cross-sectional size for the throat **30** in relation to the passage **66**. As a result, the crusher has a longer period of effective operation during which it may be "choke fed" because the throat **30** may accommodate a relatively large volume of material even though the mantle **42** is raised to several different axial positions with regard to the bowl **44** (adjusting wear).

It is also to be noted that the shape of the section **52**, defines a "downstream" edge **68** at a substantial taper with the further objective of avoiding the development of a flare or bell shape for the mantle **42** as described above with wear and use of the crusher.

As indicated above, the particular shape of the mating mantle and bowl elements has been determined to be significant with regard to the deposition of hard facing in a layer of at least 7/16-inch thickness. That is, the sections **50** and **52** comprise hard facing metal and are well in excess of ½inch thickness (somewhat critical for effective wear resistance). In this regard the application of hard facing metal (over 2.5 percent carbon and over 12 percent chromium) in thickness over even one-quarter of an inch to gyratory crushers have generally resulted in spalling. That is, the formative shape of prior crushers of the type here considered have generally been considered to involve destructive impact forces which will readily destroy or spall any hard facing layer over ¼inches. However, it has been determined that by forming the crusher in the shape disclosed above, hard facing, applied in layers of at least seven-sixteenths inch in thickness are durable and do not spall.

In forming the sections **50** and **52**, the alternate layer technique described above has been discovered to be particularly well suited. Specifically, alternate layers **70** and **72** are provided of metal having different hardness. The layers **70**

comprise a chromium steel with at least 2.5 percent carbon and 12 percent chrome, while the layers **72** comprise chromium steel including at least 4 percent carbon and 30 percent chrome. Each layer is deposited in a continuous bead of arc welded metal, as by revolving the entire structure past a welding unit as well known in the prior art.

The system hereof as indicated above, may be effectively employed to manufacture or rebuild conical or gyratory crushers with mating linearly tapered surfaces comprising a substantial final layer of hard metal to resist resulting abrasive forces. Various forms hereof may be developed utilizing various techniques although the specific structure described herein has been determined to be effective. Thus, the scope hereof is defined by the appended claims.

I claim:

1. An improved mating mantle-bowl structure for a crusher wherein a drive unit provides a gyratory movement between said mantle-bowl structure to afford a crushing action, comprising:

a mantle defined as a figure of revolution and including an externally defined conical section of substantially linear external taper and an external throat portion thereabove, said mantle comprising a base metal casting with an external surface layer extending over said externally defined conical section comprising a hard metal in relation to said base metal and being of at least seven-sixteenths of an inch in thickness; and

a bowl member for telescopically receiving said mantle, said bowl member including an internally defined conical section of substantially linear internal taper to mate with said externally defined conical section of said mantle, and further including an external throat portion above said internally defined conical section, said bowl member comprising a base metal casting with an internal surface layer extending over said internally defined conical section, said internal surface layer comprising a hard metal in relation to said base metal and being of at least seven-sixteenths of an inch in thickness.

2. A structure according to claim **1** wherein said layers of hard metal are arc weld deposited.

3. A structure according to claim **1** wherein said mantle and bowl members define a substantially enlarged annular feeding throat above said sections of linear taper.

4. A structure according to claim **1** wherein said surface layers comprise a plurality of layers of weld metal of different individual hardness.

5. A structure according to claim **1** wherein said surface layers comprise a hard metal component layer having a carbon content over 3 percent and a chrome content over 20 percent.

6. A structure according to claim **1** wherein said surface layers comprise a plurality of layers of weld metal of different individual hardness and include a hard metal component layer having a carbon content over 3 percent and a chrome content over 20 percent.