United States Patent [19]

Mertz

[11] **3,850,376**

[45] **Nov. 26, 1974**

[54] **MANTLE FOR A GYRATORY CRUSHER**

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[73] Assignee: **Fuller Company,** Catasugua, Pa.

[22] Filed: **June 25, 1973**

[21] Appl. No.: **373,572**

[52] **U.S. Cl.** **241/207,** 241/293, 241/295

[51] **Int. Cl.** **B02c 2/04**

[58] **Field of Search** 241/207–216, 241/293–295

[56] **References Cited**

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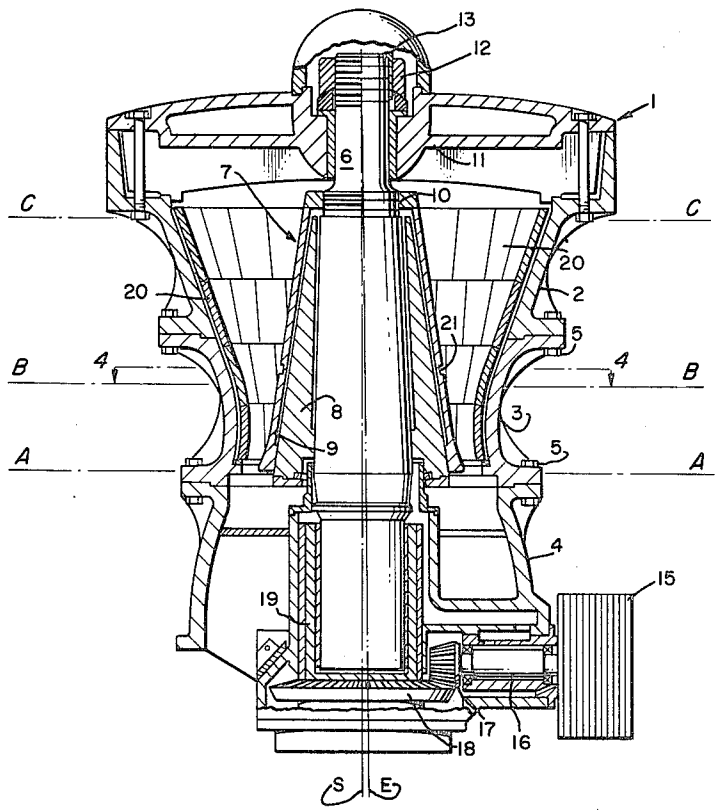
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Assistant Examiner—Howard N. Goldberg
Attorney, Agent, or Firm—Frank H. Thomson

[57] **ABSTRACT**

A mantle for a gyratory crusher having a generally truncated conical shape and having a lower portion which is subjected to a greater crushing stress than the upper portion. The upper surface portion has at least one groove which is concentric with the axis of the mantle. During crushing operations, the mantle will grow due to the stresses applied during crushing. This growth will normally result in a bulging of the mantle. The groove in the mantle will permit the mantle to grow thereby reducing bulging. If the mantle is made of two pieces, the groove may be located at the junction of the two pieces.

19 Claims, 9 Drawing Figures



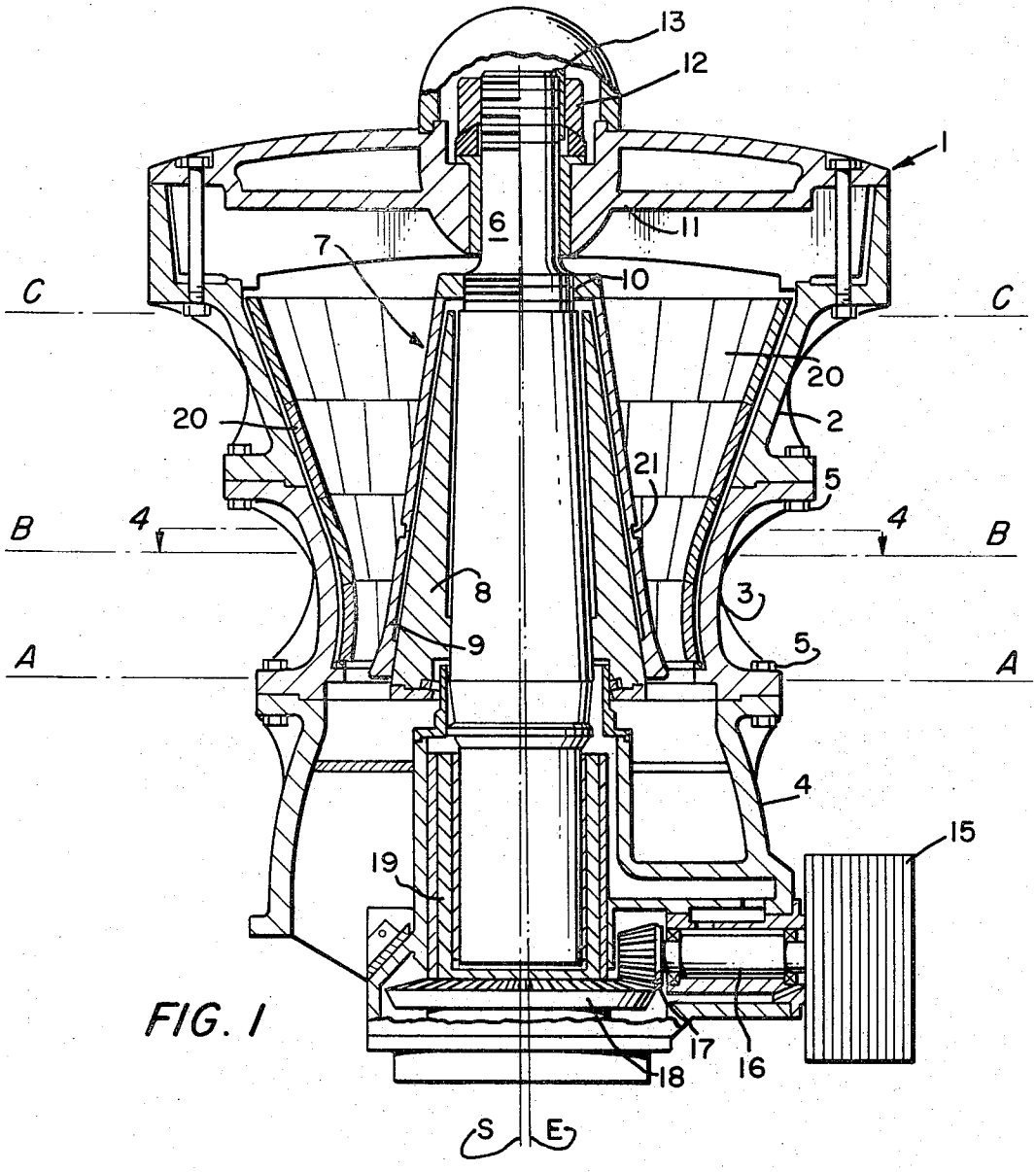


FIG. 1

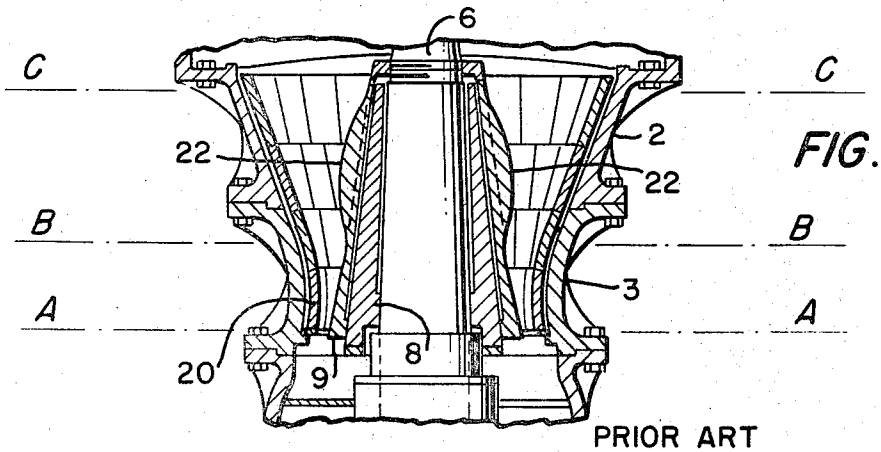


FIG. 2

PRIOR ART

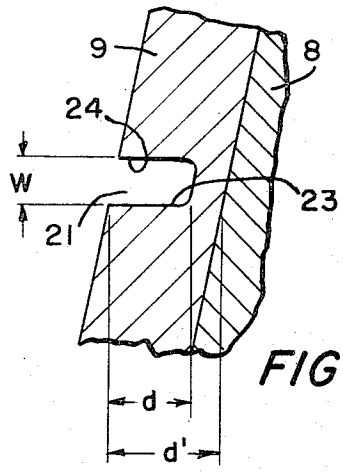


FIG. 3

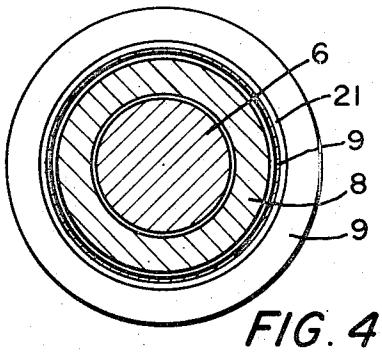


FIG. 4

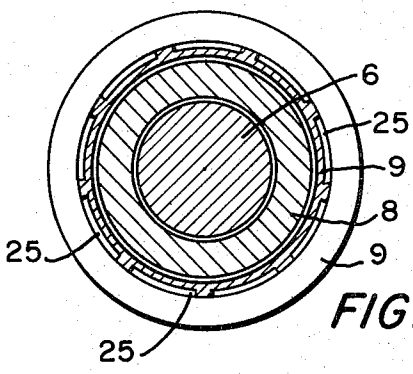


FIG. 5

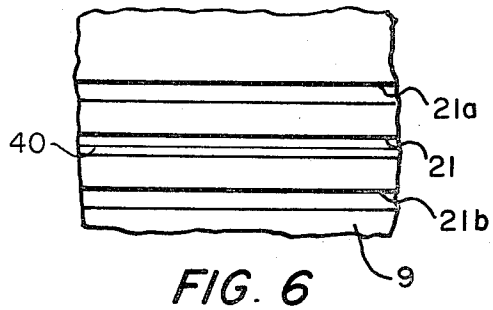


FIG. 6

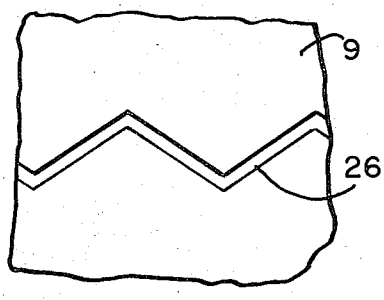


FIG. 7

FIG. 8

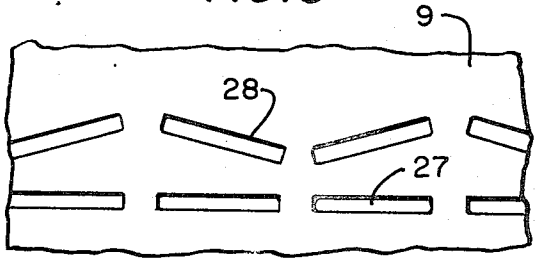
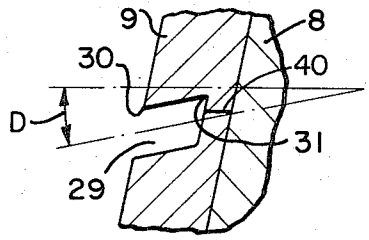


FIG. 9



MANTLE FOR A GYRATORY CRUSHER

BACKGROUND OF THE INVENTION

The present invention relates to an improved mantle for a gyratory crusher. Gyratory crushers include a hollow, usually inwardly tapering concave and a generally outwardly tapering or conical head mounted for gyratory movement within the concave. Some means is provided for making the head gyrate relative to the concave. As the head moves towards the concave at any point along the gyratory path of the head, material such as rock is crushed between the head and the concave. As the head moves away from the concave, material falls downwardly through the crusher. As the material falls through the crusher, it may be subjected to repeated crushing forces.

The concave and the head are normally covered with wearing parts which are replaced after a period of operation. These parts may be made from a wearable material such as manganese steel. The wearing part which is secured to the head is usually referred to as the mantle. The mantle is often fixed to the head by means of a lock nut and zinc or epoxy poured between the head and the mantle.

The subjection of the mantle to repeated crushing forces often causes the mantle to stretch. However, since the mantle is fixed on the head, as by a head nut, growth of the mantle material is restrained along the axis of the head.

It has been observed in the operation of gyratory crushers that the generally conical surface of the mantle becomes deformed in a relatively predictable manner after long use. The manner of deformation generally results in the mantle material bulging outwardly from the conical surface along a portion of the surface above the area of greatest stress.

This bulging produces an increase in head diameter above the working zone, thus interfering with the flow of material through the crusher, and building up crushing stresses in the bulge area. In addition, the stretching of the mantle can cause failure of the threads on the lock nut which holds the mantle in place, or eventual cracking of the mantle. Either of these occurrences may result in crusher shutdown and necessitate mantle replacement. In general, the stretching of the mantle material will shorten mantle life.

The area of greatest stress in a gyratory crusher is generally the lower portion of the mantle which is subjected to the hardest crushing work and greatest wear. Because of the shape of the concaves and the head, this is usually in the lower third of the crusher. By the present invention, at least one groove is placed in the mantle circumferentially around the mantle to permit the mantle to grow without bulging.

Prior to the present invention, grooves have been used in crusher wearing parts. One such arrangement is shown in U.S. Pat. No. 3,497,146, but these grooves are located in the area of highest crushing forces and are designed to hold material in the crushing chamber. Retaining material in the grooves will tend to prevent the mantle material from gradually closing the groove and would therefore retard the operation of the present invention.

Although various groove arrangements have been employed in the face plates of jaw crushers which have planar crushing surfaces, it is not believed that the known techniques would be suitable for gyratory crushers.

Frequently, mantles for large gyratory crushers are made in two or more parts with the split being made between the upper and lower portions of the mantle. Since the area of greatest stress is in the lower portion of the crusher, that portion will wear faster than the upper portion. By making the mantle in two pieces, the lower portion of the mantle may be changed without changing the upper portion. In this manner, the mantle material which makes up the upper portion need not be wasted. The present invention may be utilized as a two part mantle by locating the groove at the junction where the two parts are joined, or the invention may be utilized as a single piece mantle by controlling the location of fracture, permitting the fracture to occur at the groove and thus permitting the replacement of only that part of the mantle which is worn.

SUMMARY

It is, therefore, the principal object of this invention to provide a mantle for a gyratory crusher which will overcome the disadvantages of mantles of the prior art by providing a mantle which will decrease the undesirable deformation of the mantle due to crushing stresses and thereby increase mantle life.

It is a further object of this invention to provide a crusher having wearing parts such as the mantle on the crusher head which increases the length of time the crusher may operate without changing wearing parts.

It is another object of this invention to provide a mantle for a gyratory crusher which can effectively control the mantle fracture point so that damaged parts of the mantle can be replaced economically and efficiently.

In general, the foregoing and other objects of the present invention will be achieved by providing a mantle for use with a gyratory crusher including a normally fixed concave and a head mounted for gyratory movement relative to said concave whereby when said head gyrates, material between said concave and said head is crushed, said mantle comprising: wearing material generally shaped as a truncated cone adapted to be mounted on the head of a crusher and having an area of greatest stress when material is being crushed; said mantle having at least one groove in the surface thereof above the area of greatest stress.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in connection with the annexed drawings wherein:

FIG. 1 is a sectional view of a gyratory crusher employing one embodiment of the mantle of the present invention;

FIG. 2 is a fragmentary view similar to FIG. 1 but on a reduced scale showing a mantle for a gyratory crusher according to the prior art;

FIG. 3 is a fragmentary sectional view on an enlarged scale of a portion of the present invention;

FIG. 4 is a top view of the mantle of the present invention taken along lines 4—4 of FIG. 1;

FIG. 5 is a view similar to FIG. 4 which shows another embodiment of the present invention;

FIG. 6 is an enlarged fragmentary elevational view of the mantle of the present invention showing still another embodiment of the present invention;

FIG. 7 is a view similar to FIG. 6 showing still another embodiment of the present invention;

FIG. 8 is a view similar to FIG. 7 showing still another embodiment of the present invention; and

FIG. 9 is a view similar to FIG. 3 showing still another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention provides an improved mantle for a gyratory crusher. Referring to FIG. **1**, a portion of a conventional gyratory crusher is shown generally at **1**. Large crushers generally consist of a top shell **2**, middle shell **3**, and bottom shell **4**, fastened together by bolts **5** to form a generally inverted truncated cone which is lined with wearable material. Main shaft **6** carries the breaking head shown generally as **7**, which comprises crushing head core **8**, head mantle **9** which is made of wearable material and head nut **10** which fixes the head mantle **9** in position.

Main shaft **6** is suspended for gyratory motion within spider **11** by means of suspension nut **12**. Suspension nut **12** is prevented from rotating by means of suspension nut key **13**.

Main shaft **6** is caused to gyrate by a source of power (not shown) generally adapted to be connected to driving sheave **15**, counter shaft **16** and driving pinion **17**. Driving pinion **17** in turn causes driving gear **18** and eccentric **19** to rotate. Main shaft **6** is eccentrically suspended within eccentric **19** in such a manner that rotation of eccentric **19** causes main shaft **6** to gyrate relative to the shell which is lined with sections of wearable material which form the concaves **20**. The gyration of main shaft **6** can be understood in terms of the main shaft axis S and eccentric axis E. The crusher is designed so that main shaft axis S describes the surface of an acute cone wherein the eccentric axis E is coincident with the center line of the crusher, and the apex of the cone is located within spider **11**.

Therefore, the rotation of eccentric **19** causes head mantle **9** to approach the concaves **20** and crush material seated between the crushing surfaces formed by head mantle **9** and the concaves **20**. Both the head mantle **9** and the concaves **20** are normally formed from wearable material such as manganese steel. As head mantle **9** recedes from the concaves **20**, the fragments of crushed material fall to a new seat at a lower level and are again crushed as head mantle **9** approaches concaves **20**. As the material falls lower through the crushing zone, more surface area of material per unit volume is presented to the mantle head **9** to be crushed because of the decrease in material particle size. As a result of both the reduction in particle size and the convergence of head mantle **9** and concaves **20** in the lower area of the gyratory crusher, it has been observed during the operation of crushers that the zone of greatest work is generally between lines A—A and B—B of FIGS. **1** and **2**, which represent approximately the lower one-half to one-third of head mantle **9**.

The effect of the crushing operation on the material which comprises head mantle **9** is a strain deformation of the mantle surface which causes the upper portion of head mantle **9** to gradually assume a generally annularly convex shape, known to those skilled in the art as "growth."

Referring to FIG. **2**, a gyratory crusher of the prior art has been shown. The same numerical designations have been retained from FIG. **1** in FIGS. **2** through **9** where no change is indicated. Thus, growth **22** is seen sectionally as a convex surface which is formed on head mantle **9** between the dashed lines indicating the original surface of head mantle **9** before operation of the crusher and the solid curved line indicating the surface after operation of the crusher. It is believed that the growth **22** occurs during extensive operation of the crusher as the mantle material moves from the area of greatest work shown approximately between lines A—A and B—B, towards the area of least work shown approximately between lines B—B and C—C. Head nut **10** prevents the elongation or growth of mantle material upwardly beyond head nut **10**. This restraint imposed by head nut **10** upon head mantle material causes the head mantle material to bulge outwardly in the unrestrained direction, that is radially from the main shaft **6**. The resulting deformation appears as the convexly shaped growth **22**.

In an effort to decrease the deformation and growth of head mantle **9**, at least one groove **21** is located in the upper portion of head mantle **9** concentrically with the axis of main shaft **6**. Therefore, the area of groove **21** will gradually decrease as the mantle material gradually moves upwardly as described previously. In other words, referring to FIG. **3**, lower groove surface **23** will approach upper surface **24** as the mantle material deforms. Therefore, the amount of growth **22** as shown by the dashed lines on the prior art drawing, FIG. **2**, will be diminished for a given period of crushing operation by using the groove **21** of the present invention.

The second advantage of the present invention is the ability to control the location of mantle fracture which may occur in severe cases of wear and deformation. The present invention will therefore control the location of mantle fracture to within acceptable limits for easy replacement of worn parts. It is believed that the point of fracture of head mantle **9** will be consistently confined to the area within groove **21**. Providing a predictable point of fracture will facilitate replacement of the lower portion of head mantle **9**, increase salvageability of either portion of the mantle, and decrease the time which the gyratory crusher must be shut down for repair.

The groove as shown in FIG. **3** shows the dimensions of a typical groove **21** of the present invention. It is believed that groove **21** will effectively provide the advantages of the present invention if the depth of the groove d is approximately between two-thirds and three-fourths the depth of mantle d'. Conversely stated, the depth of mantle material in the plane of the groove **21** will be approximately between one-third and one-fourth, respectively, of the surrounding mantle head depth d'. It is believed that the decreased depth of mantle material at the groove will create a predicably weaker mantle cross-section at which the mantle **9** will consistly fracture after severe wear.

It is believed that width w of groove **21**, approximately between one-third and two-thirds the mantle depth d', will provide groove **21** with sufficient area to absorb the growth of mantle material throughout a long period of crusher operation. As the mantle material deforms from the area of greatest work shown as approximately between lines A—A and B—B of FIGS. **1** and **2**, the area of groove **21** will be diminished by this material until the area of the groove reaches zero as a limit. It is believed that as a result of the invention, only

negligible deformation of mantle head 9 in the area between approximately B—B and C—C will occur during this period of crusher operation.

Referring now to FIG. 4, the present invention is shown as at least one groove 21 which lies in a concentric circle about the axis of main shaft 6. It will be seen that groove 21 may be continuous throughout its circumference, or interrupted as shown in FIG. 5 as groove 25. Furthermore, a plurality of grooves 21, 21*a* and 21*b* as shown in FIG. 6 may be used. It will be readily understood that grooves 21, 21*a* and 21*b* may each also be either continuous or interrupted and that therefore many combinations of grooves will be within the objects of the present invention.

FIG. 7 shows still another embodiment of the present invention wherein at least one groove 26 is shown in a saw-tooth manner along a circle which is concentric with main shaft 6. Again, it will be readily understood that a plurality of grooves 26 would be possible within the purpose of the present invention, and that the saw-tooth pattern may be either continuous or interrupted.

FIG. 8 shows still another embodiment of the present invention wherein a combination of at least one interrupted concentric groove 27 and at least one saw-tooth groove 28 is illustrated.

FIG. 9 shows yet another modification of the present invention wherein at least one groove 29 is shown at a slope D with the horizontal plane so that outer groove point 30 along the surface of head mantle 9 is at a lower crushing level than inner groove point 31. It is believed that downward slope D will tend to prevent the entrance of crushed material into groove 29 and will allow any crushed material which may have entered to be dislodged due to the force of gravity.

The mantle 9 may be made of two pieces each of which will be shaped as a truncated cone. With a two-piece mantle it is preferred that the grooves 21 or 29 be located at the junction of the pieces. This is shown at 40 in FIG. 9. If there is more than one groove in the mantle the junction of the pieces will be at one of the grooves as shown in FIG. 6.

It will be understood that the above description of the present invention is susceptible to various modifications, changes, and adaptations, and that the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

I claim:

1. A mantle for use with a gyratory crusher including a normally fixed concave and a head mounted for gyratory movement relative to said concave whereby when said head gyrates, material between said concave and said head is crushed, said mantle comprising:

wearable material generally shaped as a truncated cone adapted to be mounted on the head of a crusher and having an area of greatest stress when material is being crushed; said mantle having at least one groove in the surface thereof above the area of greatest stress for compensating for deformation of the wearable material caused by stress applied to the wearable material when material between the concave and the head is crushed whereby said groove will decrease in area when the wearable material deforms.

2. A mantle for use with a gyratory crusher according to claim 1 wherein said groove extends substantially circumferentially around said mantle.

3. A mantle for use with a gyratory crusher according to claim 2 wherein said groove is uninterrupted and is substantially normal to the longitudinal axis of the mantle.

4. A mantle for use with a gyratory crusher according to claim 1 wherein said groove has a saw-tooth pattern which extends substantially circumferentially around the mantle.

5. A mantle for use with a gyratory crusher according to claim 1 wherein there are a plurality of grooves in the mantle aligned with each other to form an interrupted groove which extends circumferentially around the mantle.

6. A mantle for use with a gyratory crusher according to claim 5 wherein each of said grooves is substantially normal to the longitudinal axis of the mantle.

7. A mantle for use with a gyratory crusher according to claim 1 wherein there are a plurality of grooves in the mantle, each being above the area of greatest stress on the mantle.

8. A mantle for use with a gyratory crusher according to claim 7 wherein at least one of said grooves extends substantially circumferentially around the mantle and is substantially normal to the longitudinal axis of the mantle.

9. A mantle for use with a gyratory crusher according to claim 1 wherein said mantle is made of at least two pieces each of which is generally shaped as a truncated cone and adapted to be mounted on the head of a crusher to form a mantle which is generally shaped as a truncated cone and said groove is located at the junction of the pieces.

10. A mantle for use with a gyratory crusher according to claim 9 wherein there are a plurality of grooves in said mantle, one of which is located at the junction of the pieces.

11. A mantle for use with a gyratory crusher according to claim 1 wherein said groove has a depth of about two-thirds the radial thickness of the mantle.

12. A crusher comprising first and second crushing members and a wearing part mounted on at least one of said crushing members; at least one of said crushing members being movable relative to the other of said crushing members whereby when one of said crushing members moves toward the other crushing member, material is crushed; said crushing members and said wearing part being shaped so that the area of hardest work is in the lower portion of the wearing part; said wearing part having at least one groove in the surface thereof above the area of hardest work and having an uninterrupted surface in the area of hardest work; said groove being adapted to decrease in area to compensate for deformation of the material due to stress applied to the wearable material when material is crushed.

13. A crusher according to claim 12 wherein said first crushing member is a normally fixed concave and said second crushing member is a conical head mounted for gyratory movement relative to said concave and said wearing part is mounted on said head.

14. A crusher according to claim 13 wherein said wearing part has a generally truncated conical shape and said groove extends substantially circumferentially around said wearing part.

15. A crusher according to claim 14 wherein said groove is substantially normal to the longitudinal axis of the head and is uninterrupted.

16. A crusher according to claim 13 wherein said groove has a saw-tooth pattern which extends circumferentially around the wearing part.

17. A crusher according to claim 13 wherein there are a plurality of grooves in the wearing part aligned with each other to form an interrupted groove which extends circumferentially around the wearing part.

18. A crusher according to claim 12 wherein said wearing part is formed in two pieces and said groove is located at the junction of the two pieces.

19. A crusher according to claim 18 wherein there are a plurality of grooves in the wearing part and at least one of them is located at the junction of the two pieces.

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