ABSTRACT

Liner assemblies for the bowl and mantel of a gyratory cone crushing machine. Each assembly includes a liner backing plate formed from a material of low abrasion resistance, such as mild steel, and which takes the form of a truncated cone to conform to the associated bowl or mantle. The crushing surface of the liner assembly is defined by a plurality of arcuate segments cast from martensitic white iron or steel and having a thickness substantially greater than that of the backing plate. The segments are arranged in ring fashion on the backing plate and secured thereto with a resilient adhesive such as urethane.

17 Claims, 6 Drawing Figures
3,834,633 BOWL AND MANTLE ASSEMBLY FOR CONE CRUSHERS

This is a continuation of application Ser. No. 243,688, filed Apr. 13, 1972, and now abandoned. The invention is directed to an improved liner assembly for either or both the bowl and mantle of a gyratory cone crushe r machine.

Gyratory cone crushers are used in the mining industry for reducing ore to a predetermined fine size for further processing. Typically, gyratory cone crushers comprise a stationary conical bowl which opens downwardly and has a central opening in its top to receive feed material. A conical mantle is disposed beneath the bowl and is eccentrically rotated for gyro troty crushing movement with respect to the mantle. The bowl and mantle each includes a liner assembly replaceably mounted thereon and which defines the actual crushing surface. U.S. Pat. No. 1,873,671, issued to E. B. Symons on Aug. 23, 1932 is an exemplary representation of a gyra tory cone crushing machine.

Because the liner assembly for the bowl and mantle are subjected to extreme forces in the reduction of ore to fine size, their wear rate is often extreme, particularly in the processing of very hard ore. This necessi tates the replacement of the respective liner assemblies at periodic intervals, and it will be appreciated that such replacement results in a significant down time of the machine. This is particularly critical since many ore processing operations continue 24 hours a day.

The use of liner assemblies formed from material of great abrasion resistance has been a long felt need, but it has not been possible to form such materials in the necessary conical configuration. As an example, either martensitic white iron or martensritic steel is an ideal material from the standpoint of abrasion resistance, but both are brittle and undergo a significant volume change as they pass from the austenitic stage to mart enritic form. In other words, it is extremely difficult to form from martensitic white iron or steel an article of size and configuration such as a bowl or mantle since the transformation to martensite (as the result of rapid cooling) cracks the liner, rendering it useless in an ore crushing application. Consequently, the material most often used for bowl and mantle liners is manganese steel, which offers a relatively good resistance to impact although its resistance to abrasion is low.

Another disadvantage of known bowl and mantle liner assemblies is the mating of assembly parts, which requires close tolerance machining to insure proper contact. Conventional liners have consisted of a support plate which can be of mild steel, which directly engages the bowl or mantle and has a wear surface (e.g., manganese steel) affixed thereto. To provide an effective fit between the support plate and wear surface material, machining has been necessary.

Our invention is directed to an improved liner assembly for either or both the bowl and mantle of a gyratory cone crushing machine. The inventive liner assembly comprises a support plate of mild steel or the like taking the form of a truncated cone, and a plurality of arcuate wear segments, preferably formed from martensitic white iron or martensitic steel, which are collectively arranged on the support plate in a ring fashion and secured thereto with a resilient adhesive. In the preferred embodiment, the resilient adhesive is urethane, and it not only provides an adhesive bond between the respective segments and support plate, but also between adjacent edges of the segments themselves. Due to their size and shape, the segments can be made from martensitic white iron or steel without the fear of crack formation. The use of a resilient adhesive provides a thickness of material which conforms to both segments and support plate thereby eliminating the need for close tolerance machining. It is the segmented approach which permits the use of highly abrasion resistant materials for the wear segments, which in turn provides a significantly greater wear life for each liner assembly. The ability to use wear materials such as martensitic white iron enables the gyratory cone crushing machine to operate more efficiently, both from the standpoint of ore crushing and less down time of the machine.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of a gyratory cone crushing machine including segmented bowl and mantle liner assemblies which embody the inventive principle;

FIG. 2 is a plan view of the bowl liner assembly viewed from the bottom looking up;

FIG. 3 is a plan view of the mantle liner assembly from the top looking down;

FIG. 4 is a fragmentary top plan of the bowl liner assembly, portions thereof broken away;

FIG. 5 is a sectional view of the bowl liner assembly taken along the line 5—5 of FIG. 4;

FIG. 6 is a sectional view of the mantle liner assembly taken along the line 6—6 of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1, a gyratory cone crushing machine represented generally by the numeral 11 is shown in section. The particular structure and operation of cone crushing machine 11 form no part of this invention, and reference is made to U.S. Pat. No. 1,873,671, issued to E. B. Symons on Aug. 23, 1932 for a more detailed description of this structure.

Briefly, machine 11 comprises a bowl structure 12 which is adjustably supported in a stationary, although upwardly yielding position by frame work 13 and a plurality of springs 14. A liner assembly for the bowl structure 12 is represented generally by the numeral 15 and is described in greater detail below. Bowl liner assembly 15 is secured to the bowl structure 12 by a plurality of lugs 16 which protrude through openings 17 and are received by a like number of hooking members 18.

Disposed immediately below the bowl structure 12 is a mantle 21 which is mounted on a large shaft 22. As is evident in FIG. 1, shaft 22 is canted slightly from the axis of bowl structure 12, and it is eccentrically driven by means not shown to effect gyrotratory movement of the mantle 21 with respect to the bowl structure 12. A liner assembly for the mantle 21 is represented generally by the numeral 23, and it is secured to the mantle by a collar ring 24 which is wedged downwardly by abutting engagement with a threaded ring member 25.

It will be appreciated from the foregoing description that each of the bowl and mantle liner assemblies 15 and 23 are removable to permit periodic replacement after becoming worn.

The ore to be processed is fed through an inlet 26 in the top of machine 11, and on to a feed plate 27 mounted on the shaft 22 for gyrating movements therewith. The ore is thus fed over the sides of the feed plate.
27 into a hopper 28 which communicates with the gyrating bowl and mantle liner assemblies 15 and 23. The ore is thus progressively crushed with gyrating movement and thereby reduced in size to be subsequently dropped from between the liner assemblies for further processing.

With reference to FIGS. 2, 4 and 5, the bowl liner assembly comprises a backing or support plate 31 which takes the form of a truncated cone. Support plate 31 is preferably made from mild steel, and it defines an integral, continuous ring having a plurality of circumferentially arranged rectangular openings 32 formed therein.

Bowl liner assembly 15 further comprises a plurality of arcuate wear segments 33, each being substantially greater in thickness than the support plate 31 and having the lug 16 integrally formed therewith. The lug 16 is centrally located on the wear segment 33 for projection through opening 32, thus enabling the liner assembly 15 to be mounted on the hooking members 18.

Wear segments 33 are made from material which is highly abrasion resistant, preferably martensitic white iron or martensitic steel. Thus, it will be apparent that the crushing surface which the wear segments 33 present to processed ore is high abrasion resistant, whereas the support plate 31, which is more ductile but offers less resistance to abrasion, abutably engages the bowl structure 15.

The wear surface or face of segments 33, as best seen in FIG. 5, is chosen for the particular crushing application, and forms no part of the present invention. As best shown in FIGS. 4 and 5, the rear face of each wear segment 33 is formed with a small ridge 34 which peripherally extends across its top edge and down each of the side edges to leave a slot opening along the bottom edge. A shoulder 35 (FIG. 5) is also formed at the base of lug 16 to abut the upper wall or edge defining the rectangular opening 32. With the support plate 31 in an inverted position, the several wear segments 33 can be arranged in ring fashion, the position of each segment being determined by cooperation of the lug 16 and opening 32. Further, the wear segments 33 are spaced from the support plate 31 by the ridge 34, thus enabling each segment to be secured to the support plate 31 by a resilient adhesive 36. Preferably, resilient adhesive 36 is urethane, the liquid form of which is poured into the aforesaid opening to subsequently form a strong adhesive bond between the spaced surfaces. As shown in FIG. 4, the arcuate length of the segments 33 is chosen so that a gap is left between adjacent segments, and this gap is also filled with the resilient adhesive 36. Thus, the several wear segments 33 are adhesively secured to the support plate 31 and to each other to provide an improved liner assembly 15 for the bowl structure 12.

With reference to FIGS. 3 and 6, mantle liner assembly 23 also includes a support plate 37 similar to the support plate 31 of bowl liner assembly 15, and a plurality of arcuate wear segments 38. As best shown in FIG. 3, the outer face of support plate 37 has a plurality of lugs 39 formed thereon which are essentially rectangular in shape and arranged in lower and upper circular rows. The wear segments 38 are equal in size, and the lugs 39 are circumferentially spaced so that each wear segment 38 will cooperate with three of the lugs 39.

Like the plate 31, support plate 37 takes the form of a truncated cone and is preferably made from mild steel to provide a strong continuous backing surface for the wear segments 38.

The sectional view of FIG. 6 shows each wear segment to have an irregular outer face; although, as with the wear segments 33, this shape is determined by the particular crushing application and forms no part of this invention. The outer segment face includes a concave recess 41 which defines a circumferential recess with all of the wear segments 38 assembled to receive the collar 24. Below the concave recess is a crushing surface 42 which engages the surface 40 of an opposed segment 33, and the outer surface terminates in a skirt portion 43.

The inner surface of each wear segment 38 has three rectangular recesses or receptacles 44 formed therein to receive the lugs 39. The depth of recess 44 is slightly less than the projecting dimension of the lugs 39, and it will therefore be appreciated that the wear segment 38 will be spaced from the support member 37 when properly placed thereon. As with the bowl liner assembly, its spacing is provided to receive a thickness of resilient adhesive 45 (preferably urethane) which strongly affixes the respective segments 38 to the support plate 37 in ring configuration. As before, each of the segments 38 has an arcuate length chosen to define a radial gap with adjacent segments (FIG. 3), and this gap is also filled with resilient adhesive 45 in order for the segment 38 to be adhesively secured to each other as well as to the support plate 37.

Although there is metal to metal contact in each of the bowl and mantle linear assemblies 15 and 23, the urethane nevertheless provides a resilient backing to the wear segments 33 and 38 at points between the ridges 34 or lugs 39. Thus, the concept of segmenting the bowl and liner assemblies permits the use of much harder (and more brittle) materials; and the use of a thickness of resilient adhesive not only enables the brittle, abrasion resistant wear segments to be firmly secured to the continuous, nonbrittle support or backing plate, but also reduces the chance of breaking a wear segment by absorbing and distributing the crushing forces. The result of our invention is a liner assembly for either or both the bowl and mantle of a gyratory cone crushing machine which entirely avoids the virtually insurmountable problem of integrally casting highly abrasion resistant materials, which eliminates the machining of mating surfaces, which crushes more efficiently (by reason of the use of highly abrasion resistant materials) and which offers a significantly longer wear life.

We claim:
1. A removeable liner assembly for the bowl of a gyratory crusher having a plurality of hooking members adapted to receive and retain the liner assembly, comprising:
   a. a backing plate essentially taking the form of a truncated cone with a central opening therein and made from material having a predetermined resistance to abrasion;
   b. a plurality of wear segments constructed for mounting on the backing plate and collectively defining a crushing surface, each segment formed from material having a resistance to abrasion greater than that of the backing plate;
   c. said backing plate having an opening for each of said wear segments;
d. each wear segment having a lug member disposed on the backside thereof, each lug member constructed and arranged to project through its associated opening in the backing plate for retaining engagement with one of said hooking members; e. and each wear segment being secured to the backing plate with a resilient adhesive.

2. The liner assembly defined by claim 1, wherein the resilient adhesive is urethane.

3. The liner assembly defined by claim 1, wherein the wear segments are formed from martensitic white iron.

4. The liner assembly defined by claim 1, wherein the wear segments are constructed and arranged on the backing member to define a gap between adjacent segments, said gaps being filled with said resilient adhesive to secure adjacent segments to each other.

5. The liner assembly defined by claim 1, wherein each of said lug members further comprises a shoulder portion disposed at its base for abutting engagement with the wall defining said opening.

6. The liner assembly defined by claim 1, wherein one of said backing plate and wear segments has ridge means disposed thereon for spacing the respective segments from the backing plate, the resilient adhesive being disposed in said space.

7. The liner assembly defined by claim 6, wherein the ridge means are disposed on the back side of said wear segments, comprising a ridge extending around at least a portion of the periphery of said segment back side.

8. A removable liner assembly for a gyratory crusher having a conical bowl and mantle relatively moveable in gyratory fashion, the liner assembly constructed for use with one of said bowl and mantle and comprising:
   a. a backing plate essentially taking the form of a truncated cone with a central opening therein and made from material having a predetermined resistance to abrasion;
   b. a plurality of wear segments constructed for mounting on the backing plate and collectively defining a crushing surface, each segment formed from material having a resistance to abrasion greater than that of the backing plate;
   c. one of said backing plate and wear segments having a plurality of lugs of predetermined size and shape projecting therefrom;
   d. the other of said backing plate and wear segments having a like number of recesses conforming in size and shape to the projecting lugs and disposed for cooperative engagement therewith;
   e. and said wear segments being secured to the backing plate with a resilient adhesive.

9. The liner assembly defined by claim 8, wherein the depth of said recesses is less than the projecting dimension of each of said lugs to effect spacing of the wear segments from the backing plate, the resilient adhesive being disposed in said space.

10. The liner assembly defined by claim 8, wherein the projecting lugs are disposed on the backing member in circular rows.

11. The liner assembly defined by claim 1, wherein the wear segments are arcuately shaped and identically sized to collectively define a truncated conical crushing surface.

12. The liner assembly defined by claim 1, wherein the wear segments are formed from martensitic steel.

13. The liner assembly defined by claim 8, wherein the resilient adhesive is urethane.

14. The liner assembly defined by claim 8, wherein the wear segments are formed from martensitic white iron.

15. The liner assembly defined by claim 8, wherein the wear segments are formed from martensitic steel.

16. The liner assembly defined by claim 8, wherein the wear segments are constructed and arranged on the backing member to define a gap between adjacent segments, said gap being filled with said resilient adhesive to secure adjacent segments to each other.

17. The liner assembly defined by claim 8, wherein the wear segments are arcuately shaped and identically sized to collectively define a truncated conical crushing surface.

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