April 19, 1949. J. E. KENNEDY 2,467,938

REVERSIBLE MANTLE FOR GYRATORY CRUSHERS

Filed Dec. 15, 1945 2 Sheets-Sheet 1

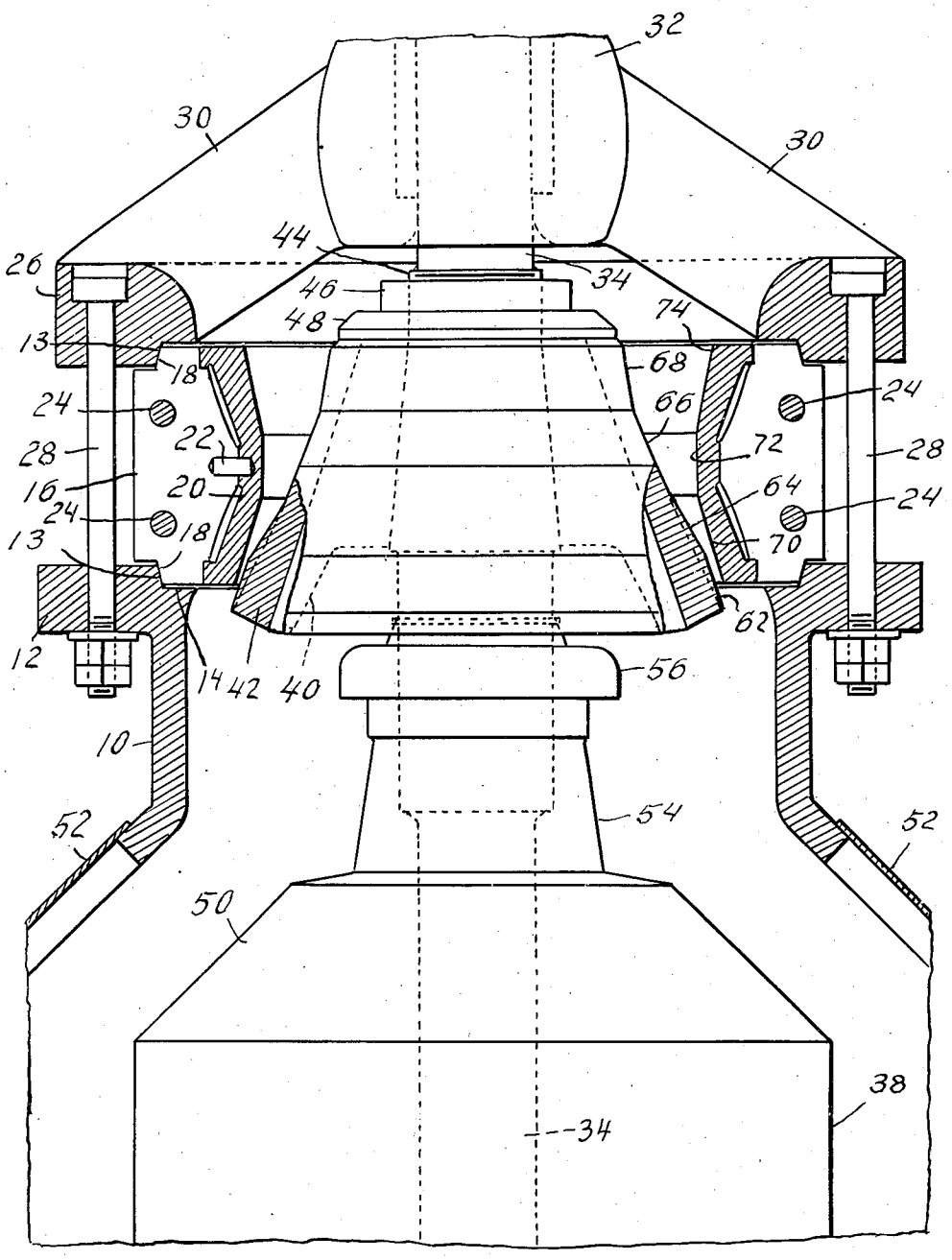


Fig. 1

INVENTOR
JOSEPH E. KENNEDY
BY
Pennie, Davis, Marvin & Edmonds
ATTORNEYS

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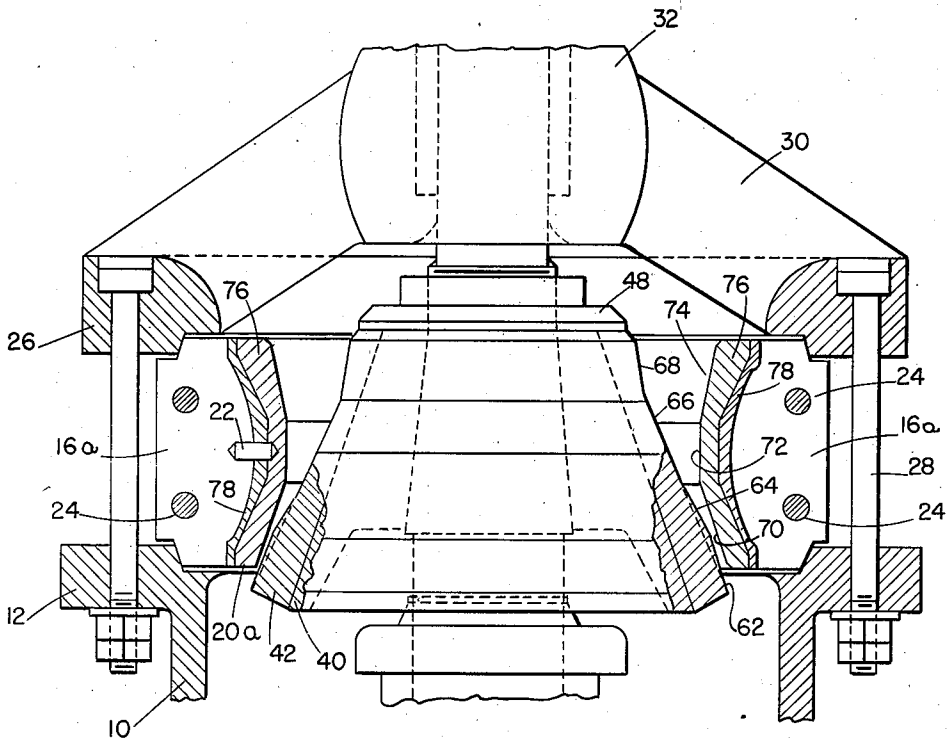


Fig. 2

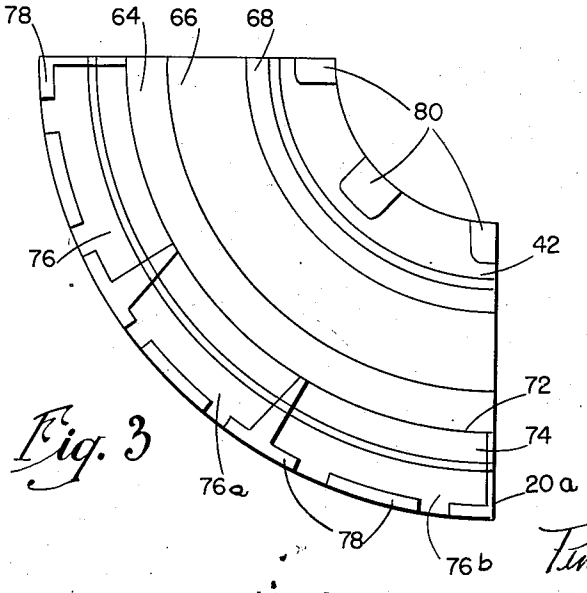


Fig. 3

INVENTOR
JOSEPH E. KENNEDY
BY
Pennie, Davis, Marvin & Edmonds
ATTORNEYS

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REVERSIBLE MANTLE FOR GYRATORY CRUSHERS

Joseph E. Kennedy, New York, N. Y.

Application December 15, 1945, Serial No. 635,215

9 Claims. (Cl. 241—299)

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This invention relates to improvements in the structure of gyratory crushers, and more particularly to improvements in a combined mantle and grinding ring construction.

Crushers of the type to which this invention relates are generally known as gyratory crushers, which may be illustrated by the crusher described in my Patent No. 1,754,895.

One of the difficulties encountered in the use of gyratory crushers for crushing stone, ore and other materials, is that as the mantle and grinding ring wear away, the space between these two elements gradually becomes greater, and the fineness of the crushed stone or ore gradually becomes larger, although certain arrangements are provided for adjusting the vertical position of the mantle as the wearing progresses. However, at some stage of the operation, the mantle and grinding ring must be replaced, and in order to do this, the upper portion of the crusher must be taken apart to remove the old grinding ring and to permit the removal of the worn mantle from the main shaft of the crusher. The mantle and grinding ring of crushers of this type are made of expensive alloy steel such as cast manganese steel, and therefore, the cost of replacing these elements is considerable.

The primary object, therefore, of the present invention is to provide an improved mantle and grinding ring combination which will have a greater length of life and which will therefore reduce the number of exchanges to be made.

A further object of the invention is to provide an improved grinding ring which is reversible, one end of which has a special construction which cooperates in an important manner with the mantle when partially worn.

According to the features of my invention, the improved mantle and grinding ring combination includes a mantle having a lower crushing section of unusual thickness and which, according to a preferred construction, includes two special inclined angles of nip on its outer periphery, a grinding ring having a lower conical-shaped surface mounted opposite the lower portion of the mantle, a substantially vertical surface mounted opposite the central portion of the mantle, and a funnel-shaped surface extending from said upright vertical surface to the top of the ring, the thickness of the ring at the top being substantially greater than at the bottom, whereby the ring may be reversed when the lower portion of the mantle and ring have been worn away, so that the extra thickness in the reversed grinding ring offsets the worn-away portion of the mantle and substantially doubles the life of the crushing elements.

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A preferred mantle construction according to my invention comprises a mantle of generally conical form but in which the outside surface includes various angles of nip, such as four in one form, the lower surface having a relatively steep angle, the next surface being somewhat less steep, and the third surface having approximately the steepness of the first, while the fourth surface is somewhat steeper than the first.

The grinding ring, according to a preferred form, is a one-piece cast ring, but it may be made up of a plurality of concaves assembled in a suitable backing.

My improved apparatus will be described more in detail hereinafter in connection with the accompanying drawings, in which:

Figs. 1 and 2 are broken vertical views partly in section showing the details of construction of the improved crushing elements, Fig. 2 showing a modified form of ring.

Fig. 3 is a quarter plan view looking down on the grinding ring and mantle of Fig. 2.

Referring to Fig. 1, the crusher comprises a lower shell 10 of annular construction and which may be a heavy casting, the shell including a heavy flange 12 and a tapered annular surface 13 extending from a shoulder 14. A split top shell 16 having upper and lower annular tapered surfaces 18, rests on the surface 13. The shell 16 is provided with suitable shoulders as shown which support outwardly extending upper and lower flanges of a grinding ring 20 mounted therein. The ring 20 is preferably a solid one-piece ring of cast manganese steel and is held in position against rotation in the shell 16 by means of two or more dowel pins 22 which may be at the juncture of the sections of the shell 16 or 90° therefrom. When the ring 20 and shell 16 are assembled, the two halves of the shell 16 are bolted together by means of bolts 24. The top of the crusher includes a spider 26 having a lower flange and shoulder construction similar to that of the upper portion of the shell 10, so as to fit the shell 16, this construction including the tapered annular surface 13 to fit the matching tapered surface 18 of the shell 16. The flange of the spider is clamped to the flange of the shell 10 by means of bolts 28. When these bolts are drawn up tight with the tapered surfaces 13 engaging the matching surfaces 18, ring 20 is held in a rigid position which makes a solid anvil against which the stone or ore is broken in the crushing operation.

The spider 26 includes two arms 30 and a bear-

ing head 32 for supporting a main shaft 34 in any suitable manner, not shown, but which may be somewhat like that shown in the above-mentioned patent.

The shaft 34 extends substantially axially downwardly through the crusher into a housing 38 in which a mechanism is mounted for gyrating the lower end of the shaft. The portion of the shaft 34 opposite the grinding ring is of generally frusto-conical form and adapted to receive a mantle core 40 which fits over the frusto-conical section of the shaft. A mantle 42 is mounted directly over the frusto-conical outer surface of the mantle core 40, and extends slightly below the ring 20. The upper part of the core and mantle are covered with a lock nut sleeve 44, a clamp collar 46 and a lock nut sealing ring 48.

The stone to be crushed is fed into the crusher through the spaces between the arms 30, and the crushed material falling off the mantle 42 slides down a wear plate 50 and is discharged from the crusher. Inspection of the discharge passages below the mantle may be made by the removal of manhole covers 52. The shaft 34 is sealed from the crushed material and dust by means of a conical-shaped cap seal 54 to which is attached a rubber hood 56, the upper portion of which is attached to the main shaft 34 under the mantle core 40.

In accordance with a preferred form of my invention, I make the lower portion of the mantle 42 extra thick and of a particular shape. As shown in the drawing, this portion of the mantle 42 differs distinctly from the standard mantle by including an integral bulbous section at the lower portion of the mantle. The extra thickness may be represented as outside of the dotted line. This particular section of the mantle as illustrated has nip surfaces 62 and 64, while the upper portion of the mantle has differently sloping nip surfaces 66 and 68.

A preferred form of grinding ring 20, as constructed and illustrated in Fig. 1, includes a lower section having a frusto-conical nip surface 70 of standard construction, which is mounted opposite the surfaces 62 and 64. The central section of the grinding ring 20 includes a substantially vertical or cylindrical surface 72 while the upper portion of the grinding ring has a funnel-shaped grinding surface 74 which is at a different angle to the surface 72 than that of the surface 70, such that the upper part of the element 20 is substantially thicker than the lower portion. In other words, the surface 74 is at a greater distance from the symmetrical shell 16 than is the surface 70. The ring 20, as shown, has three bearing surfaces on the shell 16, an upper bearing surface, a central bearing surface and a lower bearing surface, but may bear against the shell 16 its entire height.

As an example illustrative of a combination grinding ring and mantle constructed in accordance with the present invention shown in Fig. 1 and for a particular size, the top opening between the mantle and concave may be approximately four and three-quarter inches. The surfaces 62 and 64 are at angles of about 2° and 16°, respectively, with respect to the surface 70. The surface 66 is at an angle of about 26.5° with respect to the vertical surface 72, while the angle between the surfaces 68 and 74 is about 22°. The mantle is about two and seven-sixteenth inches thick at its lower end and over 2.5 inches where the surfaces 62 and 64 join. It will be understood that these angles will vary somewhat as the lower end of the main shaft 34 is gyrated to move successive areas of the perimeter of the mantle toward the grinding ring to crush the rock or other material around its outside surface. In Fig. 1 the mantle 42 is shown with its lower portion moved to the left. The crusher, as shown, is adapted to grind the material to a size of approximately one-sixteenth of an inch.

In the example, as illustrated in Fig. 1, the grinding ring for use with the mantle described above may have any suitable thickness. As an example, the thickness bearing against the lower part of shell 16 may be about one and one-half inches, while the upper thickness bearing against the shell 16 is two inches.

The construction shown in Fig. 2 of the drawings is in general the same as that shown in Fig. 1, except for a difference in the grinding ring structure and in the shape of the inner surface of the top shell. In Fig. 2 a top shell 16*a* has substantially the upper and lower bearing surfaces as the shell 16 in Fig. 1, but has a more or less regular oval inside central section which bears directly against a grinding ring 20*a* made up of a plurality of concaves 76, 76*a* and 76*b* mounted in a back casting of zinc 78. It will be noted in Fig. 2 that the zinc backing which holds the concaves 76, 76*a* and 76*b* in place fits exactly the inside surface of the shell 16*a*. The grinding ring 20*a* is reversible the same as the ring 20 described above, and the concaves 76, 76*a* and 76*b* are made thicker on the top than on the bottom so that after the lower portions of the concaves of the ring have been worn away along with the lower portion of the mantle, the ring 20*a* may be reversed and the extra thickness be taken advantage of in the manner described above in connection with Fig. 1. The concaves 76, 76*a* and 76*b* are preferably made of the same material as that of the grinding ring 20.

Fig. 3 shows a top view of the grinding ring 20*a* in its relation to the mantle 42, the mantle being shown as removed from the mantle core or without the core 40, shaft 34 and elements 44, 46 and 48. In Fig. 3, it will be noted that the concaves 76, 76*a* and 76*b* are not identical, but that the center concave 76*a* in the quarter showing, is a key concave mounted between concaves 76 and 76*b*. It will be noted furthermore that in this figure the zinc backing 78 extends between the individual concaves and that the mounting of the concaves in the zinc provides a solid grinding ring, which in use is backed up by the shell 16*a*. The concaves are of such a size and shape with respect to the positions they occupy in the ring that the intervening zinc exposed on the inner surface of the ring is comprised of relatively narrow strips which are usually not more than one-quarter inch wide.

The top of the mantle as shown in Fig. 3 is provided with pockets 80 for receiving keys on the sealing ring 48 for keying the mantle to the core 40, the upper portion of the latter having pockets, not shown, opposite to the pockets 80, as will be understood.

The grinding ring 20*a* as shown in Figs. 2 and 3 has the same surfaces 70, 72 and 74, and in the same relationship to each other as those of the grinding ring 20 of Fig. 1. In each case instead of having surface 72 as a regular cylindrical surface, it may be rounded so as to blend smoothly into the surfaces 70 and 74.

In the use of the apparatus as described and illustrated above, the lower portion of the mantle and grinding ring wear away relatively faster

than the central and upper portions, and therefore when the mantle has been worn away down to approximately the dotted line, the lower portion of the grinding ring will have become thinner to such an extent that it would normally need to be replaced. However, instead of taking the whole apparatus to pieces, and putting on a new mantle and ring, the grinding ring is simply reversed so that the thicker upper end, as shown in the drawings, is mounted opposite the worn away lower section of the mantle **42**. The extra thickness in the reversed grinding ring will compensate for the worn away lower portions of the ring and mantle, and thereby produce a combination in which the spacing between the mantle and ring is approximately that of the original spacing. With the ring reversed, the crusher now has a long period of use before the thicker section of the ring is worn down and before the mantle is worn sufficiently to require replacing.

If desired, the grinding ring and mantle **42** may be made in two or more sections similar to that of the shell **16**. The grinding ring and mantle may be made in various sizes and each may be provided with different angles of nip from those shown and described in connection with the drawings. Other changes may be made in the construction and arrangement without departing from the spirit and scope of the invention as defined by the claims.

What I claim as new is:

1. In a crusher of the gyratory type in which a mantle of generally frusto-conical form is moved in succession toward and away from portions of a surrounding grinding ring the improvement which comprises, a mantle the lower portion of which includes a substantial thickness of metal over and above that of the standard mantle, and a grinding ring reversible end for end having a lower portion of standard thickness and an upper portion which is substantially thicker than the lower portion, whereby the ring may be reversed after the lower portions of the ring and mantle have been worn away substantially to thereby increase the effective life of the grinding ring and mantle and provide a structure when the ring is reversed in which the greater thickness of the upper portion of the ring replaces the worn lower portion of the mantle.

2. A crusher as defined by claim 1 in which the lower portion of said mantle opposite the lower portion of the grinding ring includes an upwardly inclined outer frusto-conical surface of substantially steeper slope than the general slope of the mantle, and an adjoining frusto-conical surface which is substantially less steep than the general slope of the mantle.

3. A crusher as defined by claim 1 in which the mantle includes four exterior frusto-conical surfaces providing various angles of nip, the two lower surfaces being opposite the lower portion of the grinding ring of bulbous character and arranged to provide for an abnormally long wear on the mantle.

4. A crusher as defined by claim 1 in which the thickness of the top of the grinding ring is approximately one-third greater than that of the thickness of the bottom of the ring.

5. A crusher as defined by claim 1 in which the reversible grinding ring has a lower frusto-conical grinding surface, a central cylindrical grinding surface and an upper funnel-shaped grinding surface the angle of slope of which to the axis of the cylindrical surface of the ring is substantially less than the angle of slope of the lower frusto-conical surface thereto.

6. A crusher as defined by claim 1 in which the lower portion of the grinding ring has a frusto-conical grinding surface and in which the mantle opposite said surface includes two adjoining frusto-conical surfaces of different slope, the upper one of which has an angle of approximately 16° with respect to said surface of said ring and the lower of which is approximately at an angle of 2° with respect to said surface of said ring.

7. In a crusher of the gyratory type in which a mantle of generally frusto-conical form is mounted within a surrounding grinding ring, the improvement which comprises a metal end for end reversible grinding ring having a lower frusto-conical grinding surface and an upper funnel-shaped grinding surface, the thickness of the metal at the upper portion of the ring being substantially greater than that at the lower portion of the ring, whereby when the ring is reversed said extra thickness will compensate for the reduced diameter of the lower portion of the mantle resulting from wear.

8. A crusher as defined by claim 7 in which the angle of slope of said frusto-conical surface with respect to the axis of said grinding ring is substantially greater than the angle of slope of said funnel-shaped surface with respect to said axis.

9. A crusher as defined by claim 8 in which the thickness of the metal at the top of the grinding ring is approximately one-third greater than the thickness of the metal at the original bottom of the ring.

JOSEPH E. KENNEDY.

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Certificate of Correction

Patent No. 2,467,938. April 19, 1949.

JOSEPH E. KENNEDY

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 6, line 41, claim 9, for the claim reference numeral "8" read *7*;

and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of October, A. D. 1949.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.