Dec. 28, 1965 H. J. SHELTON, JR., ETAL 3,226,045

GRINDERS

Filed April 23, 1962 4 Sheets-Sheet 1

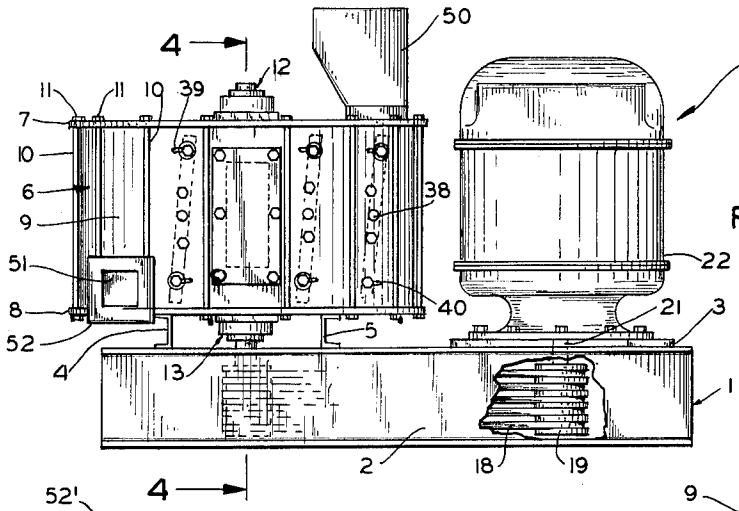


FIG. 1

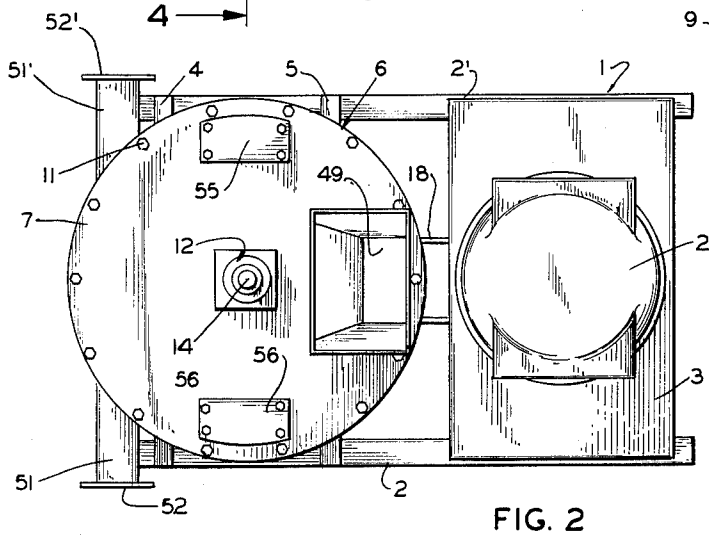


FIG. 2

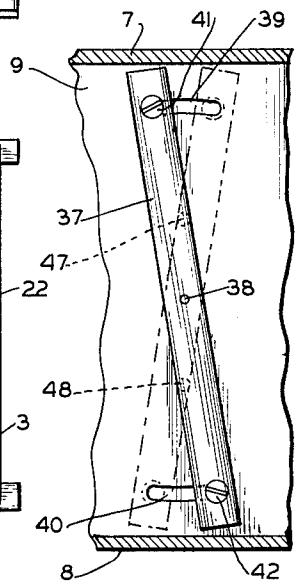


FIG. 8

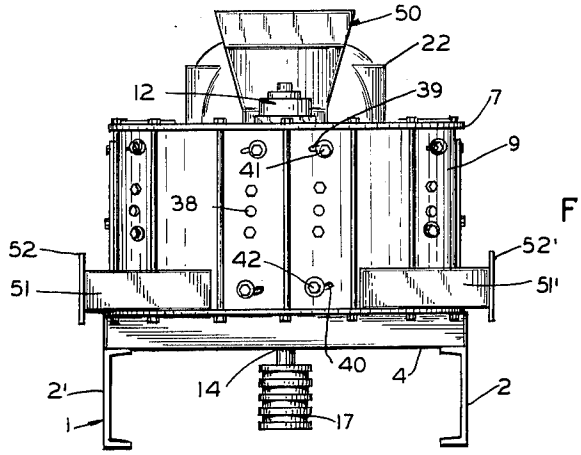


FIG. 3

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GRINDERS

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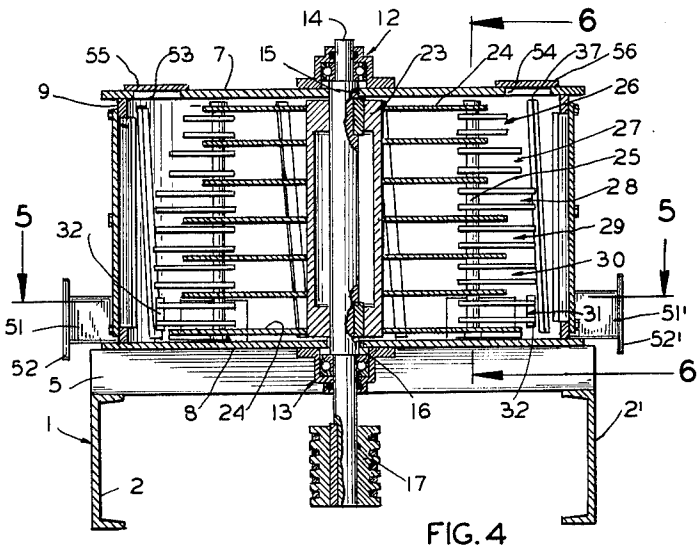


FIG. 4

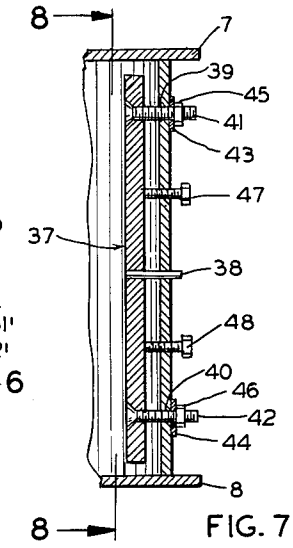


FIG. 7

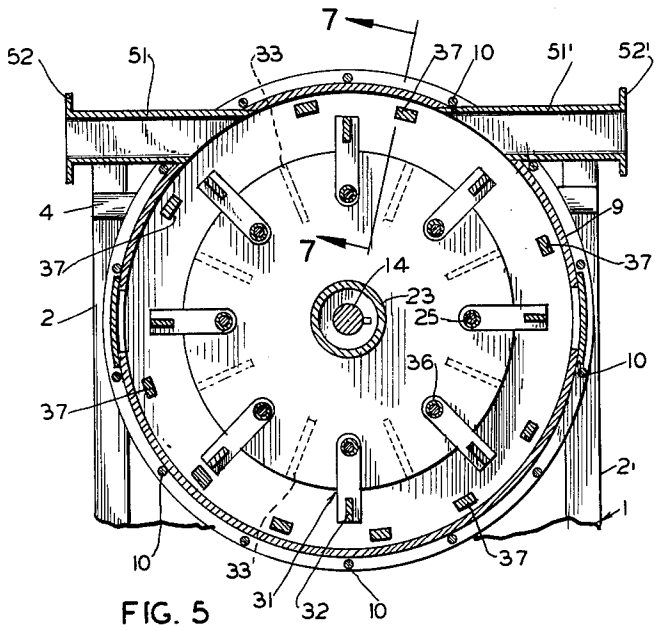


FIG. 5

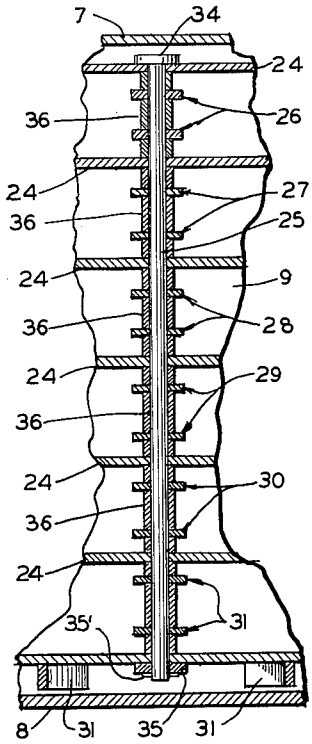


FIG. 6

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GRINDERS

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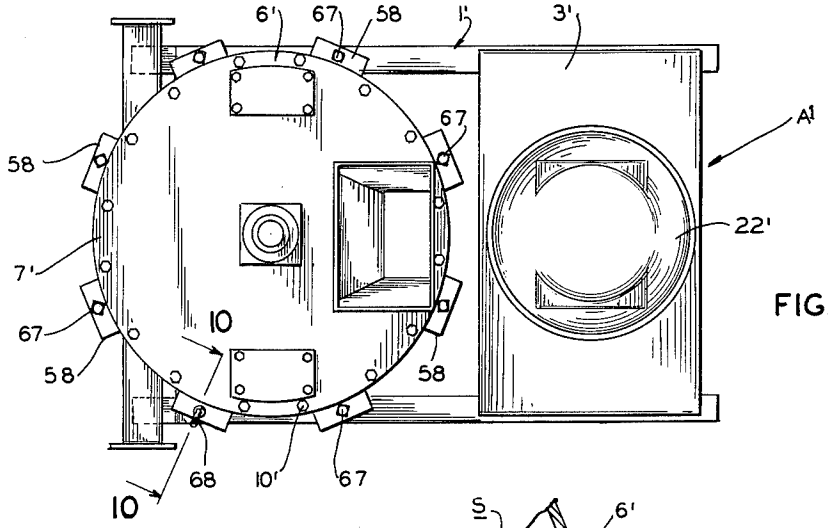


FIG. 9

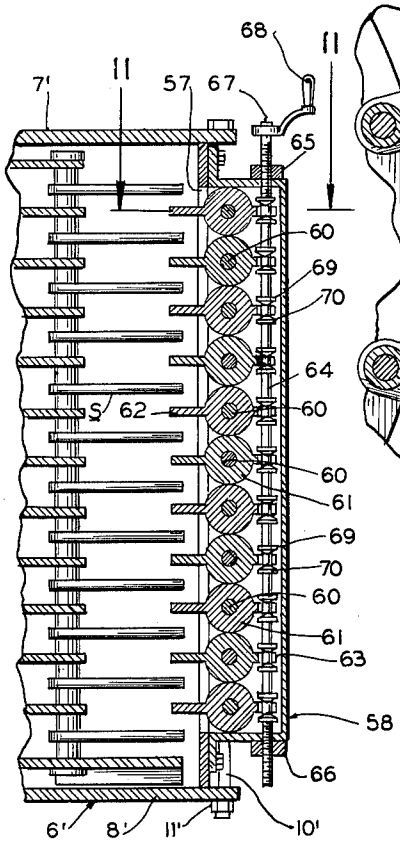


FIG. 10

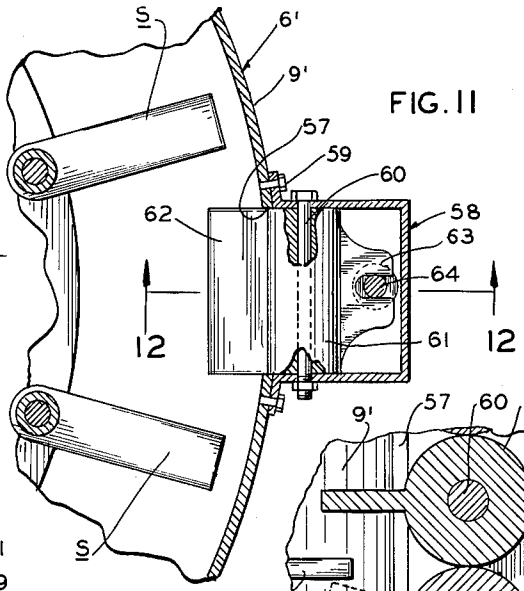


FIG. 11

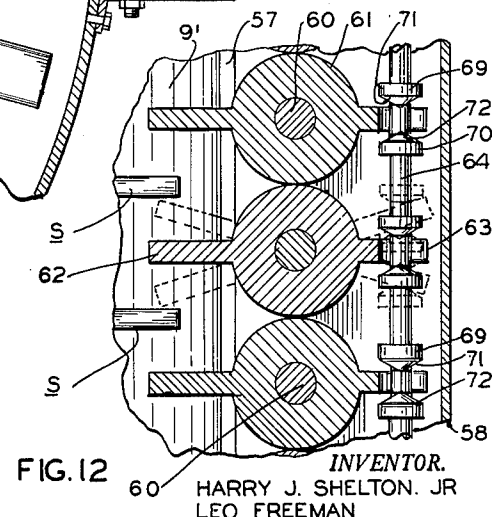


FIG. 12

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GRINDERS

Filed April 23, 1962 4 Sheets-Sheet 4

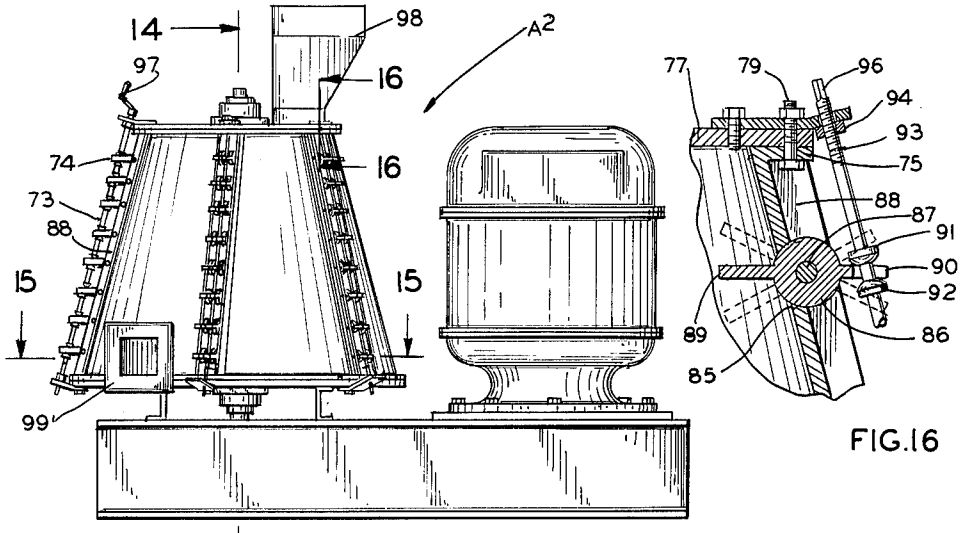


FIG. 16

FIG. 13

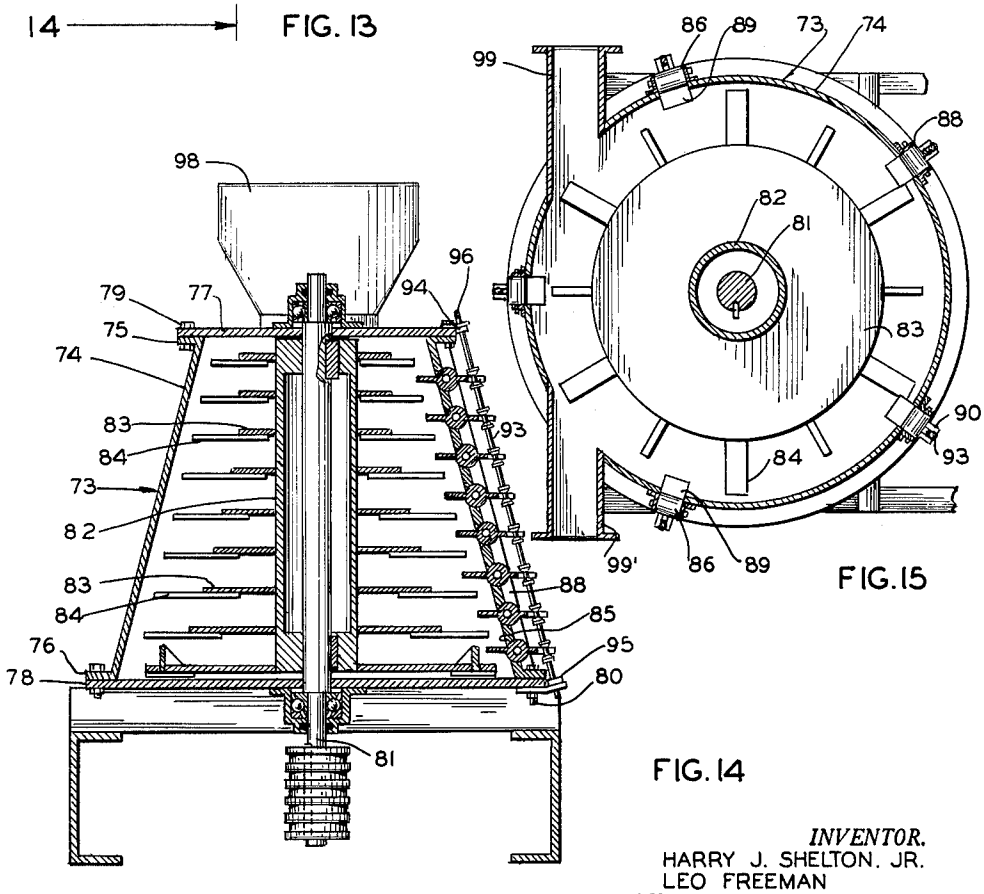


FIG. 14

FIG. 15

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United States Patent Office 3,226,045 Patented Dec. 28, 1965

3,226,045

GRINDERS

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Filed Apr. 23, 1962, Ser. No. 189,411
7 Claims. (Cl. 241—188)

This invention relates to certain new and useful improvements in grinders and, more particularly, to vertical hammermills.

Conventional hammermills ordinarily consist of a hammer shaft which is mounted in horizontal bearings and is provided with a series of axially spaced hammers which rotate in vertical planes. The input or feed to the grinder cage of a horizontal hammermill is located at the top and the incoming rock or other material to be crushed drops into the hammers along a generally downward path. After being impacted and comminuted the crushed material drops downwardly through the screen and thence through a discharge opening or chute which is located at or near the bottom of the hammer cage. Obviously, conventional hammermills are unidirectional and cannot readily be reversed. It has been found, however, that continual rotation in a single direction tends to accelerate wear on the breaker plates and hammers with the result that conventional horizontal hammermills require rather frequent repairs. On the other hand, in connection with the present invention, it has been found that by reversing the direction of rotation of the hammermill at intermittent intervals the life of the breaker plates, hammers, and other wearing parts can be extended greatly.

In addition to extending the life of wearing parts, reversibility of the hammermill has been found to have other advantages. For instance, certain types of materials tend to ball up within the hammermill and clog it. In an ordinary type of unidirection hammermill, this clogging can, in the case of certain particularly gummy or plastic materials, necessitate shutting down the hammermill at frequent intervals for purposes of cleaning out the interior of the cage and removing clogged material from the hammers. If, however, the hammermill could be reversed and the hammers caused to rotate in the opposite direction much of the clogged material would be automatically removed without necessity of shutdown.

It is, therefore, the primary object of the present invention to provide a hammermill in which the direction of the rotation of the hammers can be quickly and easily reversed without necessitating the major changes in the internal configuration of the parts of the equipment.

It is another object of the present invention to provide a hammermill in which the hammers rotate in substantially horizontal paths and can be caused to rotate in either direction.

It is a further object of the present invention to provide a hammermill of the type stated in which the discharge flows laterally with respect to the hammermill cage.

It is another object of the present invention to provide a hammermill of the type stated having breaker plates which may be quickly and conveniently adjusted to various angles and relative positions so as to vary the size and character of the output of the hammermill.

It is likewise an object of the present invention to provide a hammermill of the type stated in which the incoming material enters the hammermill cage in a direction which is truly parallel to the axis of rotation of the hammers, and, moreover, flows into the hammermill cage in a straight-line downwardly directed path.

With the above and other objects in view, our invention

resides in the novel features of form, construction, arrangement, and combination of parts presently described and pointed out in the claims.

In the accompanying drawings (four sheets)—

FIG. 1 is aside elevational view of a vertical hammermill constructed in accordance with and embodying the present invention;

FIG. 2 is a top plan view of the vertical hammermill;

FIG. 3 is an end elevational view of the vertical hammermill;

FIG. 4 is a vertical sectional view taken along line 4—4 of FIG. 1;

FIG. 5 is a horizontal sectional view taken along line 5—5 of FIG. 4;

FIG. 6 is a fragmentary vertical sectional view taken along line 6—6 of FIG. 4;

FIG. 7 is a fragmentary vertical sectional view taken along line 7—7 of FIG. 5;

FIG. 8 is a fragmentary sectional view taken along line 8—8 of FIG. 7;

FIG. 9 is a top plan view of a modified form of vertical hammermill also constructed in accordance with and embodying the present invention;

FIG. 10 is a fragmentary vertical sectional view taken along line 10—10 of FIG. 9;

FIG. 11 is a fragmentary transverse sectional view taken along line 11—11 of FIG. 10;

FIG. 12 is a fragmentary sectional view taken along line 12—12 of FIG. 11;

FIG. 13 is a side elevational view of a further modified form of vertical hammermill constructed in accordance with and embodying the present invention; and

FIGS. 14, 15, and 16 are sectional views taken along lines 14—14, 15—15, and 16—16, respectively, of FIG. 13.

Referring now in more detail and by reference to the drawings which illustrate practical embodiments of the present invention, A designates a vertical hammermill comprising a horizontal base 1 formed preferably of two heavy beam-like channels 2, 2', which are transversely connected at one end by a heavy horizontal steel plate 3, which is welded at its lateral margins to the upper flanges of the channels 2, 2'. At their opposite ends, the channels 2, 2', are transversely connected by horizontal channel-sections 4, 5, which are also preferably welded or otherwise rigidly secured to the top flanges thereof.

Rigidly secured to and extending horizontally across the top of the channel-like sections 4, 5, is a hammermill cage 6 consisting of horizontal upper and lower plates 7, 8, and an intermediate cylindrical cage-wall 9, securely held in assembled relation by means of a plurality of annularly spaced axial tie-rods 10, each of which is threaded at its opposite end and held in place by nuts 11. Rigidly mounted concentrically above the plates 7, 8, respectively, and located in precise coaxial alignment with each other, are conventional ball-bearing assemblies 12, 13, for operatively supporting a shaft 14, which extends coaxially across the cage 6 through apertures 15, 16, formed in the plates 7, 8, respectively. At its lower end the shaft 14 projects downwardly below the channel-like sections 4, 5, and terminates within the space between the channels 2, 2'. Keyed or otherwise rigidly mounted upon such lower ends of the shaft 14 is a pulley 17 which is operatively connected by means of a plurality of V-belts 18 to a similar pulley 19 which is, in turn, keyed upon the lower end of a drive shaft 20 extending vertically upwardly through a relatively large aperture 21 formed in the plate 3. The drive shaft 20 extends into and is an operative part of a conventional heavy-duty reversible electric motor 22 which is bolted in vertical position upon the top of the plate 3. Inasmuch as the motor 22 is conventional and is conven-

tionally connected to a suitable source of electrical current, neither the wiring nor the details of the motor are shown or described herein.

Keyed upon the shaft 14 and extending coaxially therealong within the grinder cage 6, is a tubular sleeve 23 which is rigidly provided with a plurality of axially spaced horizontal circular plates 24. Extending axially through the plates 24 adjacent the outer peripheries thereof is a plurality of hammer-rods 25 and swingably mounted upon each such hammer-rod 25, intermediate the plates 24, are radially outwardly extending pairs of hammers 26, 27, 28, 29, 30, and 31. As will be seen by reference to FIG. 4 the uppermost pair of hammers 26 are relatively short. The pair of hammers 27, which are directly below the pair of hammers 26, are of intermediate length, and the remaining pairs of hammers 28, 29, 30, and 31, are relatively long and are of equal length. Moreover, the lowermost pair of hammers is rigidly provided with an axially extending sweeper-bar 32. Finally, the lowermost plate 24 is provided, on its underface, with rigidly attached depending radial sweeper-blades 33, the lower horizontal margins of which are spaced upwardly a very slight distance above the upper surface of the plate 8. It will also be noted in this connection that the extremities of the long hammers 28, 29, 30, 31, and the sweeper-bars 32 are spaced inwardly by a substantial distance from the inwardly presented cylindrical face of the cage wall 9, all as best seen in FIG. 5. In other words, the hammer circle, as it is usually called, has a diametral size substantially smaller than the internal diametral size of the cage 6.

It should also be pointed out in this connection that each of the hammer-rods 25 is integrally provided at its upper end with a hardened head 34 and, at its lower end, with a washer 35, the latter being held in place by a tightly wedged retainer pin 35'. Moreover, the hammers are swingably supported upon the hammer-rods 25 between short tubular sleeves 36 so that, when necessary, the hammer-rods 25 and the various pairs of hammers 26, 27, 28, 29, 30, and 31, can be easily removed for repair or replacement.

Operatively mounted at uniformly spaced intervals around the interior of the cage wall 9 are adjustable breaker bars 37, each of which is centrally provided with a horizontal outwardly projecting pivot pin 38 extending through and being rockably mounted in the cage wall 9. At equi-distantly spaced locations above each of the pivot pins 38, the cage wall 9 is provided with arcuate slots 39, 40, having their centers of curvature coincident with the axis or center line of the pivot pins 38. Rigidly mounted in the breaker bars 37 and extending radially outwardly through the arcuate slots 39, 40, are threaded studs 41, 42, which are externally provided with washers 43, 44, and nuts 45, 46. The washers 43, 44, are sufficiently large so as to cover all or at least the greater part of the slots 39, 40, to prevent, so far as possible, any leakage of pulverized material or so-called "fines" when the hammermill A is in operation.

As may be seen by reference to FIGS. 1 and 7, the cylindrical cage wall 9 is provided with pairs of set screws 47, 48, the set screws 47, 48, in each pair being located in vertically spaced alignment and equi-distantly on opposite sides of each pivot pin 38. The set screws 47, 48, are threadedly mounted in the cage wall 9 and project interiorly into endwise abutment against the outwardly presented faces of the breaker bars 37. By loosening the nuts 45, 46, the breaker bars 37 can be adjusted inwardly or outwardly to any desired position between the hammer circle and the interior face of the cage wall 9. With the set screws 47, 48, in the desired position, the nuts 45, 46, can be drawn up tightly so that the breaker bars 37 will be rigidly held in any adjusted position. In addition to this, the breaker bars 37 can be angularly adjusted from a medial position in true axial alignment parallel to the center line of the shaft 14, to angular positions such as those shown in full lines and in dotted lines in FIG. 8.

In the extreme angular positions of adjustment, the breaker bars 37 are at ten degrees, in one direction or the other, to such medial or axial position.

The upper plate 7 is provided, adjacent its outer peripheral margin, with a somewhat rectangular opening 49 and welded upon the top face of the upper plate 7, in enclosing relationship around the aperture 49, is an intake chute 50, by which material can be fed into the interior of the grinder cage 6. Similarly welded to the cylindrical cage wall 9 and opening into the interior of the grinder cage 6 are two laterally extending coaxial discharge pipes 51, 51', which are integrally provided at their outer ends with peripheral flanges 52, 52', respectively, for connection in the usual manner to conventional discharge pipes, the latter not being shown. In this connection it should also be noted that the discharge pipes or ducts should be conventionally provided with some type of manually operable or mechanically controlled closure valve so that when discharge is flowing through one of the ducts the other can be appropriately shut off. This type of valving mechanism does not form any part of the present invention and, therefore, it is not disclosed or described specifically herein. It should be noted, however, that the discharge pipes 51, 51', are located in a tangential line adjacent to the outer periphery of the grinder cage 6 and are down in the area of the sweeper-bars 32 and sweeper-blades 33, so that the pulverized material will be propelled outwardly from the grinder cage 6 with substantial velocity.

Finally, the upper plate 7 is provided with two somewhat smaller rectangular apertures 53, 54, which are located in diametral relation to each other on opposite sides of the shaft 14, and preferably in ninety degree relation to the aperture 49. These apertures 53, 54, are respectively provided with closure plates 55, 56, which are removably bolted in place in order to provide access to the interior of the grinder cage 6 for emergency purposes.

In use, the shaft 14 can be rotated in one direction for a selected interval of time and thereupon the motor 22 can be reversed so as to drive the shaft 14 in the opposite direction. If the breaker bars 37 are in medial position, of course, it is not necessary to change the adjustment thereof when the direction of rotation of the shaft 14 is changed. However, if the particular material being ground is such that the breaker bars 37 need to be in some angular position, then, upon changing the direction of rotation of the shaft 14 it will also be necessary to adjust the angular position of the breaker bars 37. This can be very quickly done by loosening the nuts 45, 46, and swinging the breaker bars 37 about the pivot pins 38 to the correspondingly opposite position. It should be noted in this connection that the breaker bars 37 are sufficiently wide so that they will contact the set screws 47, 48, in any position of angular adjustment, all as best seen in FIG. 8. It will, of course, be apparent that when the shaft 14 is rotating in a counterclockwise direction (reference being made to FIG. 5) the discharge will be propelled through the discharge pipe 51 and, correspondingly, when the direction of rotation of the shaft 14 is reversed the discharge will be propelled through the discharge pipe 51'.

It is also possible to provide a modified form of vertical hammermill A' as illustrated in FIGS. 9 to 12, inclusive. The modified form of hammermill A' is substantially similar to the previously described hammermill A and comprises a base 1', which is substantially identical in all respect with the previously described base 4. Marginally welded to and extending horizontally across the base 1' is a plate 3' substantially similar to the previously described plate 3 and adapted for supporting a reversible electric motor 22' which is, in turn, substantially similar to the previously described elecric motor 22. Rigidly mounted at the other end of the base 1' and extending vertically thereabove, is a grinder cage 6' which is substantially similar to the previously described grinder cage 6 and includes an upper plate 7', a lower plate 8', and a substan-

tially cylindrical cage wall 9', the plates 7', 8', and cage wall 9', being held securely in assembled relation by means of vertical tie-rods 10' and nuts 11'. The shaft and hammer assembly within the cage 6' is identical in all respect with the previously described shaft 14 and the previously described hammers which are operatively associated with and carried thereby. Consequently, it is not necessary to describe this assembly again.

However, the cage wall 9' is provided at uniformly spaced intervals around its periphery with axially extending rectangular slots 57 which open outwardly into elongated rectilinear housings 58 which are rigidly mounted on the exterior face of the cage wall 9' by means of bolts 59. Mounted rigidly at their ends in and extending horizontally across the housing 58 is a plurality of uniformly spaced stationary pivot pins 60 and rockably mounted on each such pivot pin 60 is a relatively large diameter sleeve 61, the radius of which is approximately half the distance between two adjacent pivot pins 60 so that the sleeves are in lightly engaged tangential abutment so as to form a substantially imperfect wall or closure up and down the vertical length of each housing 58. Formed integrally with each sleeve 61 is a radially inwardly extending breaker plate 62 which extends inwardly in approximately mid-position between each pair of swing hammers s. Also formed integrally with each sleeve 61 and extending radially outwardly therefrom in opposite relation to the breaker plates 62 is a pair of ears 63 which, in effect, form a bifurcation which straddles an adjustment rod 64 which extends vertically through the housing 58 and is threadedly mounted at its upper and lower ends in stationary nuts 65, 66. At its upper end each threaded rod 64 projects above the housing 58 and is provided with a squared end 67 for engagement with a removable handle or crank 68 by which the adjustment rod 64 may be rotated and thus caused to translate upwardly and downwardly. At uniformly spaced intervals, each adjustment rod 64 is rigidly provided with pairs of vertically spaced abutment collars 69, 70, respectively, having somewhat arcuate contact faces 71, 72, which engage the top and bottom surfaces of the ears 63 lying therebetween. Thus, as the adjustment rod is axially translated upwardly or downwardly, as the case may be, the angular presentation of the breaker plates 62 may be varied as best seen in FIG. 12. The spacing between each pair of abutment collars is such that all the breaker plates 62 in a single housing 58 will be disposed preferably in parallel relation to each other. It will, of course, be understood that, if desired, some of the breaker plates 62 in each set can be arranged at a different angle depending upon the physical character of the material to be crushed. In any case, the set of breaker plates 62 in each housing 58 will move in unison when adjusted from one angular position to another.

It is also possible to provide a further modified form of hammermill A^2 which is substantially similar to the previously described hammermill A' except that it is provided with a tapered grinder cage 73 including a frusto-conical cage-wall 74, the latter having upper and lower peripheral flanges 75, 76, which are respectively secured to upper and lower plates 77, 78, by means of upper and lower sets of bolts 79, 80. Journaled in and extending concentrically through the grinder cage 73 is a shaft 81 having a tubular sleeve 82 keyed thereto. Rigidly mounted upon the tubular sleeve 82 is a uniformly spaced series of circular horizontal plates 83 which are of progressively larger diameter from top to bottom to conform generally to the frusto-conical shape of the grinder cage 73. Each of the plates 83 is provided around its periphery with a series of radially outwardly projecting rigid hammers 84 which are preferably of uniform length and terminate in inwardly spaced relation to the inner face of the grinder cage 73 along a frusto-conical surface of revolution.

The cage wall 74 is provided, at regularly spaced intervals, around its periphery with an axially extending series of horizontal slots 85, the margins of which are somewhat arcuate to conform to cylindrical sleeves 86 rockably mounted on pivot pins 87 which are, in turn, supported at their ends in and extend horizontally between elongated bars 88 welded upon and extending axially along the outer face of the cage wall 74 bordering the lateral extremities of the slots 85. The cylindrical sleeves 86 fit snugly but, nevertheless, rockably in the slots 85 to prevent undue leakage of "fines" and on their inwardly presented faces each sleeve 86 is integrally provided with a breaker plate 89 substantially identical in shape, purpose, and function to the previously described breaker plates 62. On their outwardly presented faces, each sleeve 86 is integrally provided with laterally spaced ears 90 which project operatively between pairs of abutment collars 91, 92, rigidly mounted in an adjustment rod 93, the latter being threaded at its ends and engaged in stationary nuts 94, 95. The adjustment rod 93 and associated elements are identical in shape, purpose, and function to the previously described adjustment rod 64 and is likewise provided in its upper end with a square-shank 96 for optional engagement with a removable handle or crank 97 which is substantially similar to the crank 68. The angle of presentation of the breaker plates 89 can thus be adjusted in the same way as previously described in connection with the breaker plates 62.

The hammermill A^2 is also provided at the top with an intake or feed chute 98 and at the bottom with laterally extending horizontal discharge pipes 99, 99', which are similar in shape, purpose, and function to the intake chute 50 and discharge pipes 51, 51'.

It should be understood that changes and modifications in the form, construction, arrangement, and combination of the several parts of the grinders may be made and substituted for those herein shown and described without departing from the nature and principle of our invention.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

1. A hammermill comprising a cage of substantially circular cross-sectional shape, a shaft operatively mounted on and extending axially through the cage in concentric relation therewith, a plurality of disks rigidly mounted on the shaft in axially spaced relation along the portion thereof which is within the cage, a plurality of hammers mounted around and projecting radially outwardly from the periphery of each disk, the outer ends of the hammers being located in inwardly spaced relation to the interior face of the cage, and elongated breaker bars mounted at uniformly spaced intervals around the interior face of the cage in the space between the cage and the outer ends of the hammers, said breaker bars being swivelly mounted for optional adjustment from a position parallel to the shaft to a position in skewed relation to the shaft.

2. A hammermill comprising a cage of substantially circular cross-sectional shape, a shaft operatively mounted on and extending axially through the cage in concentric relation therewith, a plurality of disks rigidly mounted on the shaft in axially spaced relation along the portion thereof which is within the cage, a plurality of hammers mounted around and projecting radially outwardly from the periphery of each disk, the outer ends of the hammers being located in inwardly spaced relation to the interior face of the cage, and breaker elements mounted on the interior face of the cage in the space between the cage and the outer ends of the hammers, said breaker elements being swivelly mounted for optional adjustment from a position parallel to the shaft to a position in skewed relation to the shaft.

3. A hammermill comprising a cage of substantially circular cross-sectional shape, a shaft operatively mounted on and extending axially through the cage in concentric relation therewith, a plurality of disks rigidly mounted on the shaft in axially spaced relation along the portion there-

of which is within the cage, a plurality of hammers mounted around and projecting radially outwardly from the periphery of each disk, the outer ends of the hammers being located in inwardly spaced relation to the interior face of the cage, elongated breaker bars mounted at uniformly spaced intervals around the interior face of the cage in the space between the cage and the outer ends of the hammers, said breaker bars being swivelly mounted for optional adjustment from a position parallel to the shaft to a position in skewed relation to the shaft, and means operatively associated with each breaker bar for holding it in an adjusted position.

4. A hammermill comprising a cage of substantially circular cross-sectional shape, a shaft operatively mounted on and extending axially through the cage in concentric relation therewith, a plurality of disks rigidly mounted on the shaft in axially spaced relation along the portion thereof which is within the cage, a plurality of hammers mounted around and projecting radially outwardly from the periphery of each disk, the outer ends of the hammers being located in inwardly spaced relation to the interior face of the cage, breaker elements mounted on the interior face of the cage in the space between the cage and the outer ends of the hammers, said breaker elements being swivelly mounted for optional adjustment from a position parallel to the shaft to a position in skewed relation to the shaft, and means operatively associated with each breaker element for holding it in an adjusted position.

5. A hammermill comprising a horizontal cage having a substantially smooth interior arcuate face which is substantially the surface or revolution of a straight line about an axial line, said cage also having a bottom wall provided with a substantially horizontal upwardly presented surface, a vertical shaft operatively mounted on and extending axially through the cage in concentric relation therewith and along said axial line, a plurality of horizontal disks rigidly mounted concentrically on the shaft in axially spaced relation along the portion thereof which is within the cage, the lowermost disk being provided with downwardly projecting sweeper-flanges having downwardly presented edges located in close proximity to the upwardly presented surface of the bottom wall of the cage so as to contact and sweep away fine material deposited on said bottom wall, a plurality of hammers mounted around and projecting radially outwardly from the periphery of the disks, the outer ends of the hammers being located in inwardly spaced relation to the interior face of the cage, and axially extending breaker elements mounted on the interior face of the cage in axially extending peripherally-spaced zones in the space between the cage and the outer ends of the hammers, each of said breaker elements extending for a substantial distance axially along the interior face of the cage and bridging a plurality of hammers.

6. A hammermill comprising a cage of substantially cylindrical shape, a shaft operatively mounted on and extending axially through the cage in concentric relation therewith, a plurality of disks rigidly mounted on the shaft in axially spaced relation along the portion thereof which is within the cage, a plurality of hammers mounted around and projecting radially outwardly from the periphery of each disk, the outer ends of the hammers being located in inwardly spaced relation to the interior face of the cage, and elongated breaker bars mounted at uniformly spaced intervals around the interior face of the cage in the space between the cage and the outer ends of the hammers, said breaker bars being swivelly mounted for optional adjustment from a position parallel to the shaft to a position in skewed relation to the shaft.

7. A hammermill comprising a cage of substantially cylindrical shape, a shaft operatively mounted on and extending axially through the cage in concentric relation therewith, a plurality of disks rigidly mounted on the shaft in axially spaced relation along the portion thereof which is within the cage, a plurality of hammers mounted around and projecting radially outwardly from the periphery of each disk, the outer ends of the hammers being located in inwardly spaced relation to the interior face of the cage, elongated breaker bars mounted at uniformly spaced intervals around the interior face of the cage in the space between the cage and the outer ends of the hammers, said breaker bars being swivelly mounted for optional adjustment from a position parallel to the shaft to a position in skewed relation to the shaft, and means operatively associated with each breaker bar for holding it in an adjusted position.

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