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3,174,698

ROTARY ROCK CRUSHER

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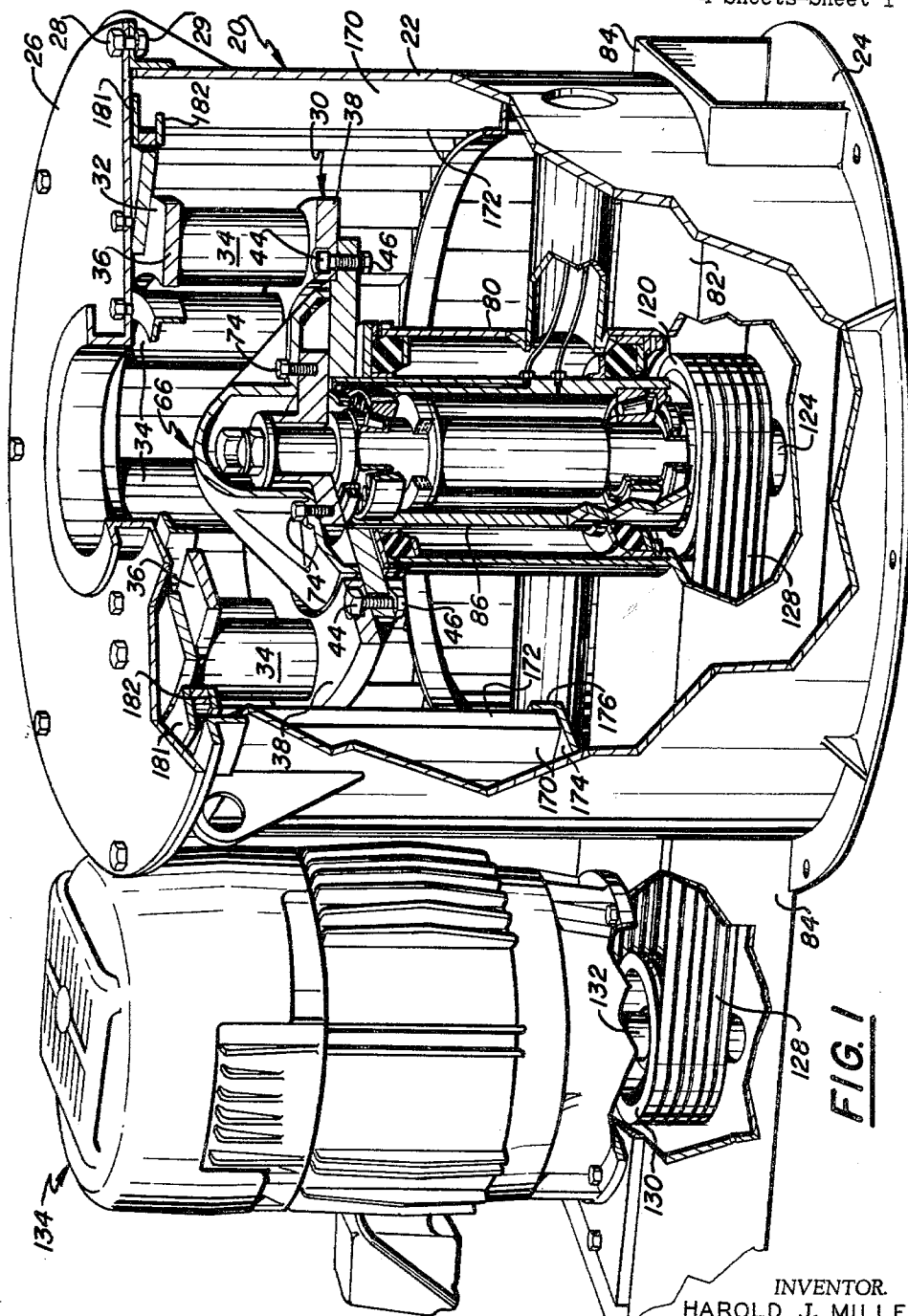


FIG. 1

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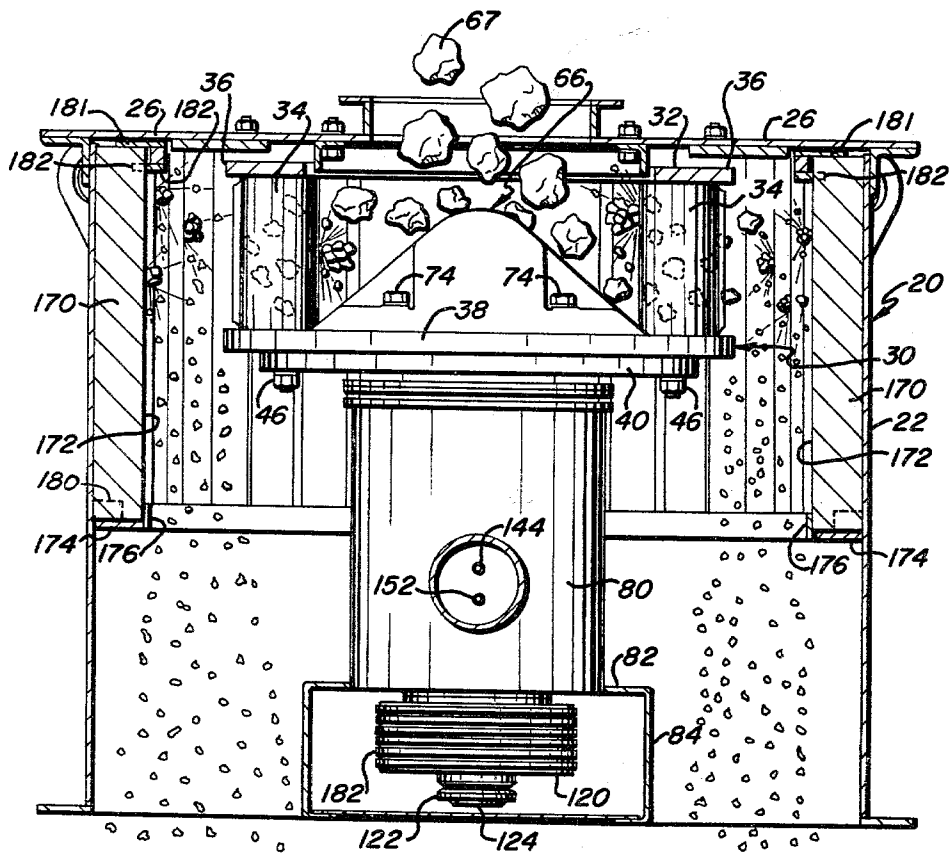


FIG. 2

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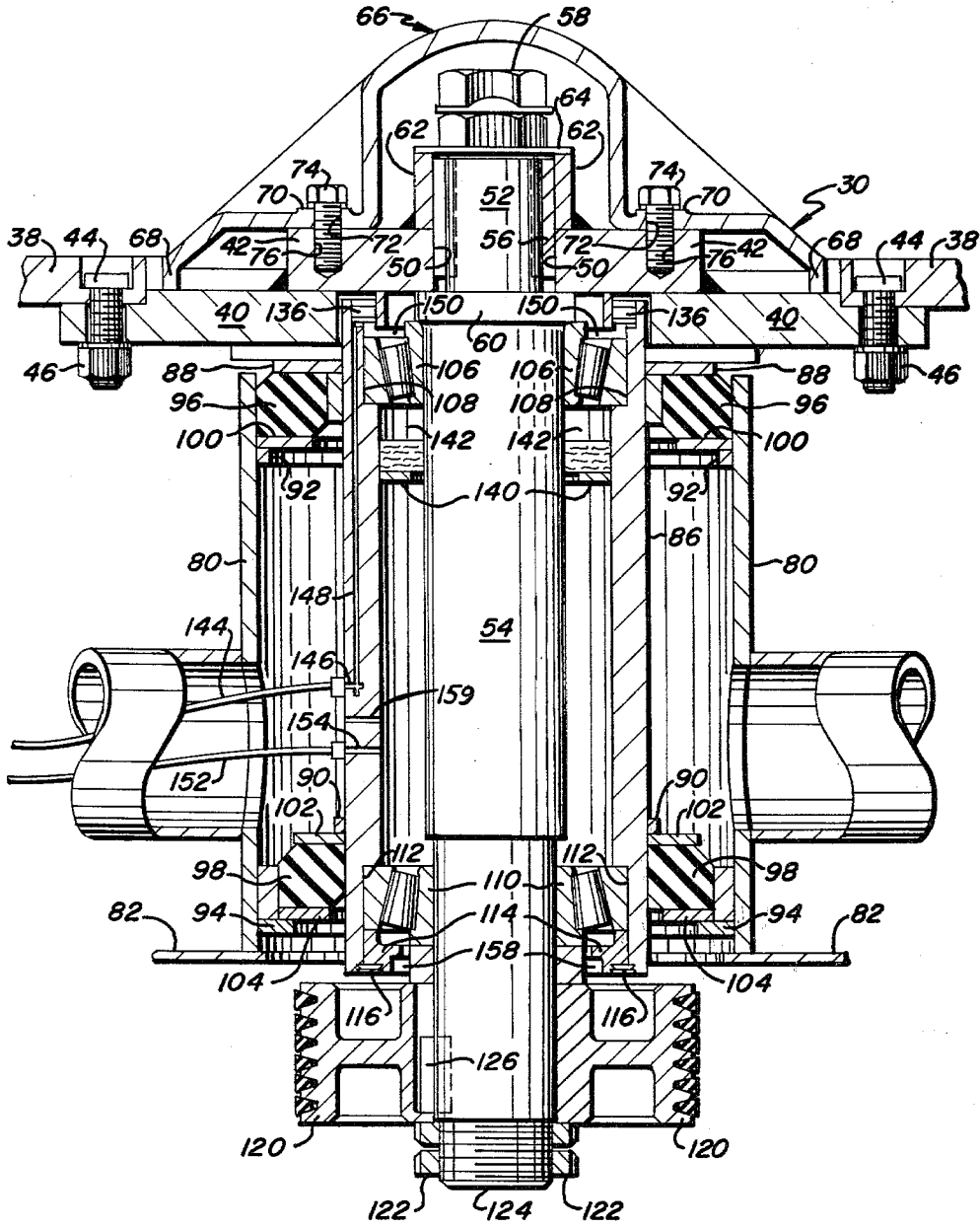


FIG. 3

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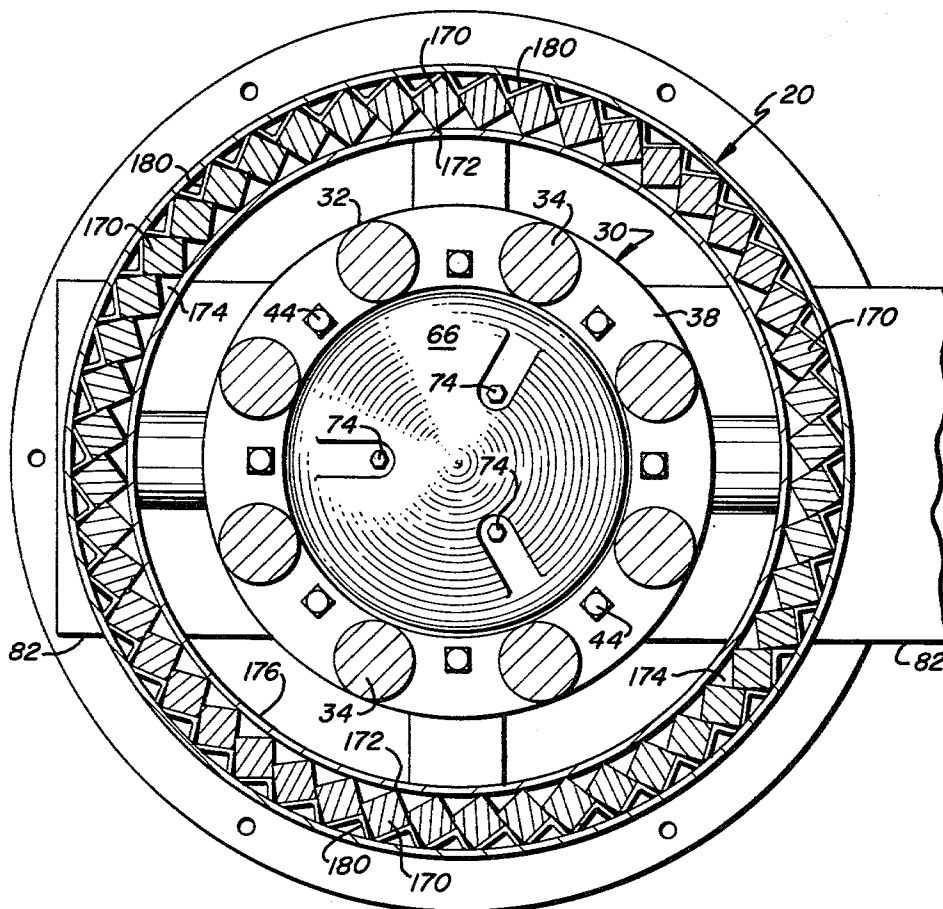


FIG. 4

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12 Claims. (Cl. 241-275)

This invention relates to rock crushing apparatus and particularly to an improved rotary crusher of the centrifugal type.

In general, the apparatus of the present invention comprises an outer cylindrical housing means fabricated from heavy steel plate material within which is rotatably mounted a cage that includes a plurality of peripherally spaced breaker pins which impart crushing impacts to the rock and also function as centrifugal impellers. The rock to be crushed is introduced through an opening in the top of the housing means so as to gravitate downwardly into the rotating cage where the rocks are fractured by the breaker pins and impelled radially outwardly against the breaker bars that line the inner surface of the housing means where additional crushing is done.

In accordance with the present invention, the cage is constructed in a novel manner so as to include a centrally positioned upwardly facing material distributing cone that confronts the intake opening in the housing means and functions to gravitationally convey the entering rock radially outwardly to the whirling breaker pins.

As another aspect of the present invention the above mentioned rotary breaker pin cage is provided with a novel resilient mounting means which permits the cage and the shaft on which it is mounted to seek their own balance whereby vibrations caused by unbalanced rock loading and uneven wear of the cage are greatly reduced.

As another aspect of the present invention the interior of the side wall of the housing means is lined with a stationary breaker bar assembly that comprises a plurality of breaker bars that are constructed and mounted in a unique manner so as to be selectively positionable to successively expose eight different wearing surfaces to the rock that is thrown centrifugally outwardly against the breaker bars by the rotating breaker pin cage mentioned above.

As another aspect of the present invention the rock crushing apparatus of the present invention is provided with a novel mounting means within the above mentioned cage and shaft assembly which permits removal of the assembly, together with the bearings that support it, upwardly through the top of the housing means simply by removing the housing cover.

It is, therefore, an object of the present invention to provide an improved rock crushing apparatus provided with an improved breaker pin cage that includes a material distributing or feed cone for efficiently delivering the entering rock from a central intake opening to the breaker pins of the cage.

It is another object of the present invention to provide an improved rotary cage type rock crusher that includes a novel resilient cage mounting means which permits the cage and shaft assembly to seek its own balance whereby vibrations are virtually eliminated. This greatly increases the life of the mill and permits installation of the apparatus on above-ground structures, thereby minimizing the cost of foundation constructions.

It is still another object of the present invention to provide a crushing apparatus of the type described that includes a novel breaker bar assembly which permits selective positioning of the breaker bars so as to successively present eight actual wearing surfaces on each bar to the centrifugally impelled rock. This greatly increases the life of the breaker bars. In addition, the breaker

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bars, due to their novel mounting arrangement, are readily replaced.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein in a preferred form of embodiment of the invention is clearly shown.

In the drawings:

FIG. 1 is a perspective view, partially in broken section, of a rock crushing apparatus constructed in accordance with the present invention;

FIG. 2 is a side sectional view of the crushing machine of FIG. 1, the section being taken along a vertical plane through the center line of the apparatus;

FIG. 3 is a partial side sectional view of a cage and cage mounting means comprising a portion of the apparatus of the preceding figures; and

FIG. 4 is a top sectional view of the crusher of the preceding figures, the section being taken along the line 4-4 of FIG. 2.

Referring in detail to the drawings, a rock crushing apparatus, constructed in accordance with the present invention is illustrated in FIG. 1 and includes a housing means indicated generally at 20 that is constructed of heavy steel plate material. The housing means comprises a cylindrical side wall 22, a bottom wall 24, and a removable top wall 26 secured in place by a plurality of circumferentially spaced bolts 28 and nuts 29.

The apparatus further includes a rotary breaker pin cage and shaft assembly indicated generally at 30.

The cage portion of the assembly 32 comprises a plurality of breaker pins 34 mounted between annular plates 36 and 38, the upper and lower ends of the pins 34 being welded to said plates or the pins can be integrally cast with the plates.

It should be pointed out that the breaker pins 34 and the upper and lower mounting plates 36 and 38 are removable as an assembly or cast as one piece. This assembly may be turned over, to present new wearing surfaces and thereby get additional crushing life.

As is best seen in FIG. 3, cage bottom plate 38 is supported on and attached to cage mounting welded assembly consisting of plates 40, 62, and 42, by a plurality of peripherally spaced bolts 44 and 46. The cage mounting assembly is provided with a central hole 50 through which is extended an upper end portion 52 of a cage mounting shaft 54.

Cage mounting assembly is keyed to the upper end portion 52 of the shaft at a key 56 and nuts 58 on the threaded upper end of the shaft serve to clamp cage mounting assembly 40, 62, and 42 against a collar portion 60 on the shaft. A washer 64 is provided beneath nuts 58 for locking the nut.

With further reference to the cage and shaft assembly, the apparatus further includes a material distributing member indicated generally at 66 which is preferably generally conically shaped so as to gravitate the rocks 67, FIG. 2, radially outwardly into the path of the breaker pins 34.

As is best seen in FIG. 3, conical member 66 includes downturned base flange 68 that rests on cage supporting assembly and a plurality of recessed flats 70 provided with holes 72 for receiving studs 74, the latter being screwed down into holes 76 in cage mounting plate 42.

With reference to FIGS. 1 through 3, the assembly is supported by a shaft mounting means 80 the lower end of which is welded to the top wall 82 of a belt housing member 84.

Within shaft mounting means 80 is disposed a bearing mounting member 86 provided with an upper radially extending flange 88 and a lower radially extending flange 90,

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said flanges 88 and 90 being welded to the outer surface of bearing support 86.

With continued reference to FIG. 3, the inner wall of shaft mounting tube 80 includes an upper inwardly extending flange 92 and a lower inwardly extending flange 94, said flanges being welded to the inner surfaces of tube 80.

Flanges 92 and 94, carried by the shaft mounting tube 80, support an upper annular resilient damping pad 96 and a lower annular resilient damping pad 98 and annular washers 100, 102, and 104 are provided to give surface contact between the supporting shoulders of the inner and outer structure and the resilient damping pads 96 and 98.

It should be mentioned that resilient damping pads 96 and 98 are formed of synthetic rubber or other suitable resilient damping material.

With continued reference to FIG. 3, an upper tapered roller bearing 106 is mounted in a recess 108 in the upper end of bearing mounting tube 86 and a lower tapered roller bearing 110 is mounted in a recess 112 on the lower end of bearing tube 86.

Referring to the lower end of tube 86, a seal 114 removably covers lower bearing 110 and is removably mounted by means of a snap ring 116.

A pulley 120 is secured to the lower end of shaft 54 by nuts 122 on the lower threaded end 124 of the shaft and is restrained against rotation by a key 126.

With reference to FIGS. 1 and 2 a plurality of V-belts 128 connect driven pulley 120 with a drive pulley 130 keyed to a shaft 132 of a prime mover which may be in the form of an electric motor indicated generally at 134.

Referring again to FIG. 3, a seal is provided between bearing tube 86 and cage supporting plate 42 by means of a resilient top seal member 136.

A felt grease seal 140 surrounds shaft 54 below upper bearing 106 to provide a lubrication chamber 142.

The top bearing member 106 is supplied with lubricant via a line 144 leading from a source of pressurized lubricant, drilled passages 146 and 148 and bearing support tube 86, the latter passage being in communication with the lubrication chamber 150 above the upper bearing member 106.

Lower bearing 110 is lubricated via a line 152 and a passage 154 through the wall of bearing support tube 86, and a lower grease seal is provided below the lower bearing as seen at 158. In addition, a vent hole 159 is provided to prevent the grease seals from being blown out during pressurized lubrication.

Referring next to FIGS. 2 and 4, the inner surface of side wall 22 of the housing means is provided with a plurality of vertically disposed breaker bars 170 of polygonal cross section, the ones illustrated being of square cross section, so as to form a plurality of inwardly facing edges 172 against which the rocks are centrifugally impelled by the previously described breaker pins 34.

As seen in FIGS. 2 and 4, breaker bars 170 are removably supported by an inwardly facing breaker bar support flange 174 provided with an upturned inner edge 176.

The orientation of breaker bars 170 is maintained by a plurality of socket forming angles 180, at the lower ends of the breaker bars, said angles 180 being welded to the inner surface of the housing wall just above breaker bar supporting flange 174.

Breaker bars 170 are also maintained oriented by a removable annular cap member 181, FIG. 2, which rests on the top of the breaker bars and includes outwardly extending angle members 182 that are secured to cap member 181 by welding. These angle members 182 form an upper socket that conforms in shape with the polygonal shape of the breaker bars.

When it is desired to change the inwardly facing edges 172 of the breaker bars top cover 26 is removed and the breaker bars are lifted upwardly and out of the sockets

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formed by the lower angle members 180 and the upper outwardly facing angle members 182. The breaker bars are then reinserted after 90 degrees rotation, to present a new breaking edge. After the four upper breaking edges are worn round, the breaker bars can be inverted to provide four new sharp breaking edges.

In operation, the rocks to be crushed are continuously introduced into the intake opening in the top of the housing means as seen in FIG. 2. As the rocks gravitate downwardly, distributing cone 66 directs them outwardly whereby they are subjected to impact action by the rapidly revolving breaker pins 34. These impacts in the cage reduce the size of the rock particles and the whirling breaker pins function as impellers that centrifugally hurl the particles outwardly against the inwardly facing edges 172 of breaker bars 170. The impacts at the breaker bars further reduce the rock size after which the particles gravitate downwardly and outwardly through the opening in the bottom of the machine.

While the form of embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow:

I claim:

1. An impact type crushing apparatus comprising, in combination housing means including a top wall provided with a central inlet opening; a plurality of breaker members mounted within said housing means and including an upper damping pad mount and a lower damping pad mount; an inner cylindrical member coaxially disposed within and spaced from said shaft mounting means; an upper annular damping pad on said upper mount; a lower annular damping pad on said lower mount, said damping pads being in supporting surrounding relationship with said inner cylindrical member whereby said member is isolated from said mounts; and forming the periphery of a crushing chamber; a vertically extending shaft mounting means in said housing means; a shaft rotatably mounted in said inner cylindrical member for rotation about a vertically extending axis; rotor means mounted on said shaft means and including a plurality of peripherally spaced impellers and a generally cone-shaped central portion below said inlet opening for directing material outwardly to said impellers; and a motor for driving said shaft means.

2. An impact type crushing apparatus comprising, in combination housing means including a top wall provided with a central inlet opening; a plurality of breaker members mounted within said housing means and forming the periphery of a crushing chamber; shaft mounting means including an outer cylindrical member secured to said housing means, an inner cylindrical member, and upper and lower spaced annular damping pads carried by said outer cylindrical member and resiliently supporting said inner cylindrical member in isolated relationship with respect to said outer cylindrical member; bearing means mounted on said inner cylindrical member; a shaft rotatably mounted on said bearing means for rotation about a vertically extending axis; rotor means mounted on said shaft means and including a plurality of peripherally spaced impellers; and a motor for driving said shaft means.

3. An impact type crushing apparatus comprising, in combination housing means including a top wall provided with a central inlet opening; an annular breaker member mounting means carried by the inner wall of said housing means and including a plurality of sockets; a plurality of breaker members including ends disposed in said sockets, each of said breaker members including a plurality of vertically extending breaker edges, each of said breaker members being selectively positionable at various keyed positions in its respective socket whereby different breaker edges can be directed radially inwardly.

4. An impact type crushing apparatus comprising, in combination housing means including a top wall provided

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with a central inlet opening; a plurality of breaker members mounted within said housing means and forming the periphery of a crushing chamber; shaft mounting means including an outer cylindrical member secured to said housing means, an inner cylindrical member, and upper and lower spaced annular clamping pads carried by said outer cylindrical member and resiliently supporting said inner cylindrical member; bearing means mounted on said inner cylindrical member in isolated relationship with respect to said outer cylindrical member; a shaft rotatably mounted on said bearing means for rotation about a vertically extending axis; rotor means mounted on said shaft means and including a plurality of peripherally spaced impellers and a generally cone-shaped central portion below said inlet opening for directing said material outwardly to said impellers; and a motor for driving said shaft means.

5. An impact type crushing apparatus comprising, in combination housing means including a top wall provided with a central inlet opening; an annular breaker member mounting means carried by the inner wall of said housing means and including a plurality of sockets; a plurality of breaker members including ends disposed in said sockets, each of said breaker members including a plurality of vertically extending breaker edges, each of said breaker members being selectively positionable at various keyed positions in its respective socket whereby different breaker edges can be directed radially inwardly; a vertically extending shaft mounting means in said housing means; a shaft rotatably mounted on said shaft mounting means for rotation about a vertically extending axis, rotor means mounted on said shaft means and including a plurality of peripherally spaced impellers and a generally cone-shaped central portion below said inlet opening for directing said material outwardly to said impellers; and a motor for driving said shaft means.

6. An impact type crushing apparatus comprising, in combination housing means including a top wall provided with a central inlet opening; an annular breaker member mounting means carried by the inner wall of said housing means and including a plurality of sockets; a plurality of breaker members including ends disposed in said sockets, each of said breaker members including a plurality of vertically extending breaker edges, each of said breaker members being selectively positionable at various keyed positions in its respective socket whereby different breaker edges can be directed radially inwardly; shaft mounting means including an outer cylindrical member secured to said housing means, an inner cylindrical member, and an annular resilient member carried by said outer cylindrical member and resiliently supporting said inner cylindrical member; bearing means mounted on said inner cylindrical member; a shaft rotatably mounted on said bearing means for rotation about a vertically extending axis; rotor means mounted on said shaft means and including a plurality of peripherally spaced impellers; and a motor for driving said shaft means.

7. An impact type crushing apparatus comprising, in combination housing means including a top wall provided with a central inlet opening; an annular breaker member mounting means carried by the inner wall of said housing means and including a plurality of sockets; a plurality of breaker members including ends disposed in said sockets, each of said breaker members including a plurality of vertically extending breaker edges, each

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of said breaker members being selectively positionable at various keyed positions in its respective socket whereby different breaker edges can be directed radially inwardly; shaft mounting means including an outer cylindrical member secured to said housing means, an inner cylindrical member, and upper and lower spaced annular damping pads carried by said outer cylindrical member and resiliently supporting said inner cylindrical member in isolated relationship with respect to said outer cylindrical member; bearing means mounted on said inner cylindrical member; a shaft rotatably mounted on said bearing means for rotation about a vertically extending axis; rotor means mounted on said shaft means and including a plurality of peripherally spaced impellers and a generally cone-shaped central portion below said inlet opening for directing said material outwardly to said impellers; and a motor for driving said shaft means.

8. An impact type crushing apparatus comprising, in combination, housing means including a top wall provided with a central inlet opening; an annular breaker member mounting means carried by the inner wall of said housing means and including a plurality of upper and lower sockets; a plurality of breaker members including ends disposed in said sockets, each of said breaker members including a plurality of vertically extending breaker edges, each of said breaker members being selectively positionable at various keyed positions in its respective socket whereby different breaker edges can be directed radially inwardly, the upper and lower ends of each of said breaker members being identical whereby each breaker member can be inverted in its respective upper and lower sockets.

9. The apparatus defined in claim 1 wherein certain of said upper and lower damping pad mounts include an upwardly facing pad supporting surface for supporting the weight of said rotor and shaft means, and a radially inwardly facing surface for resisting radially imposed forces.

10. The apparatus defined in claim 2 wherein said outer cylindrical member includes an upwardly facing pad mounting surface underlying one of said damping pads for supporting the weight of said rotor and shaft means, and a radially inwardly facing pad mounting surface for resisting radially imposed forces.

11. The apparatus defined in claim 4 wherein said outer cylindrical member includes an upwardly facing pad mounting surface underlying one of said damping pads for supporting the weight of said rotor and shaft means, and a radially inwardly facing pad mounting surface for resisting radially imposed forces.

12. The apparatus defined in claim 7 wherein said outer cylindrical member includes an upwardly facing pad mounting surface underlying one of said damping pads for supporting the weight of said rotor and shaft means, and a radially inwardly facing pad mounting surface for resisting radially imposed forces.

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