July 2, 1963 F. M. ALLEN ETAL 3,096,035

ROTARY IMPACT CRUSHER

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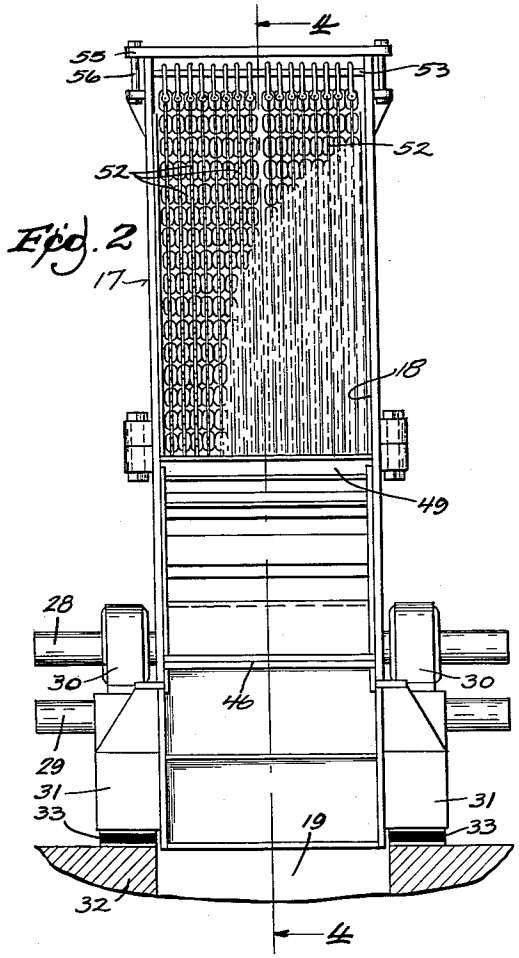



Fig. 2

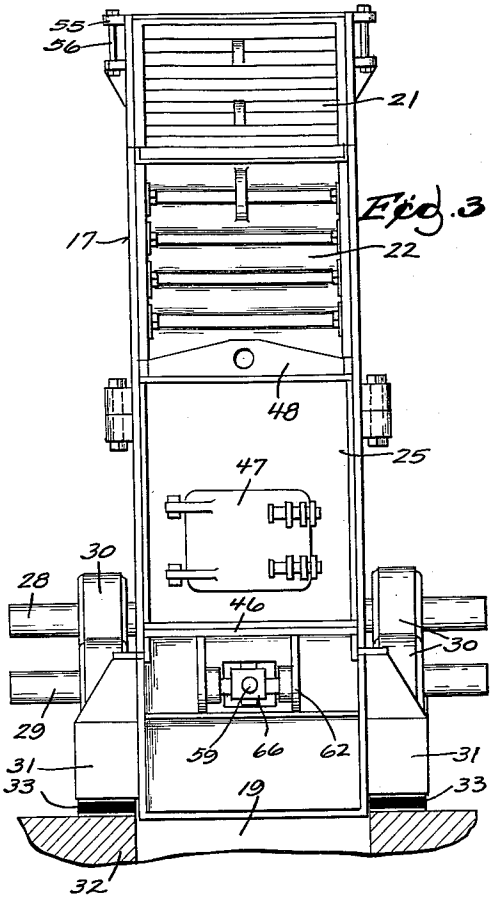



Fig. 3

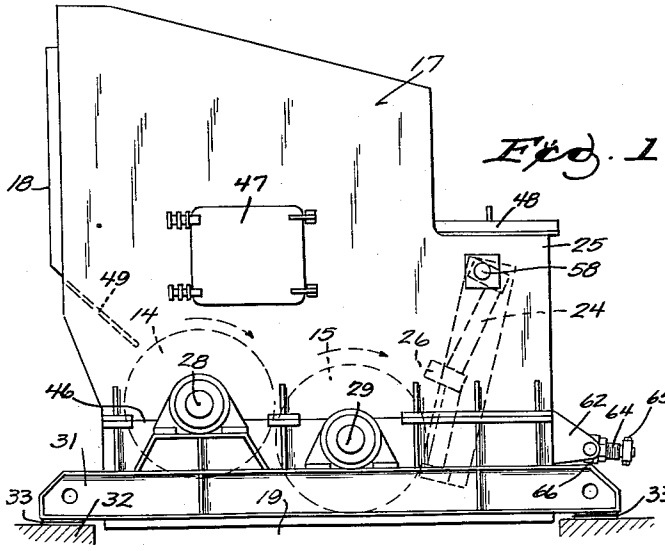



Fig. 1

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ROTARY IMPACT CRUSHER

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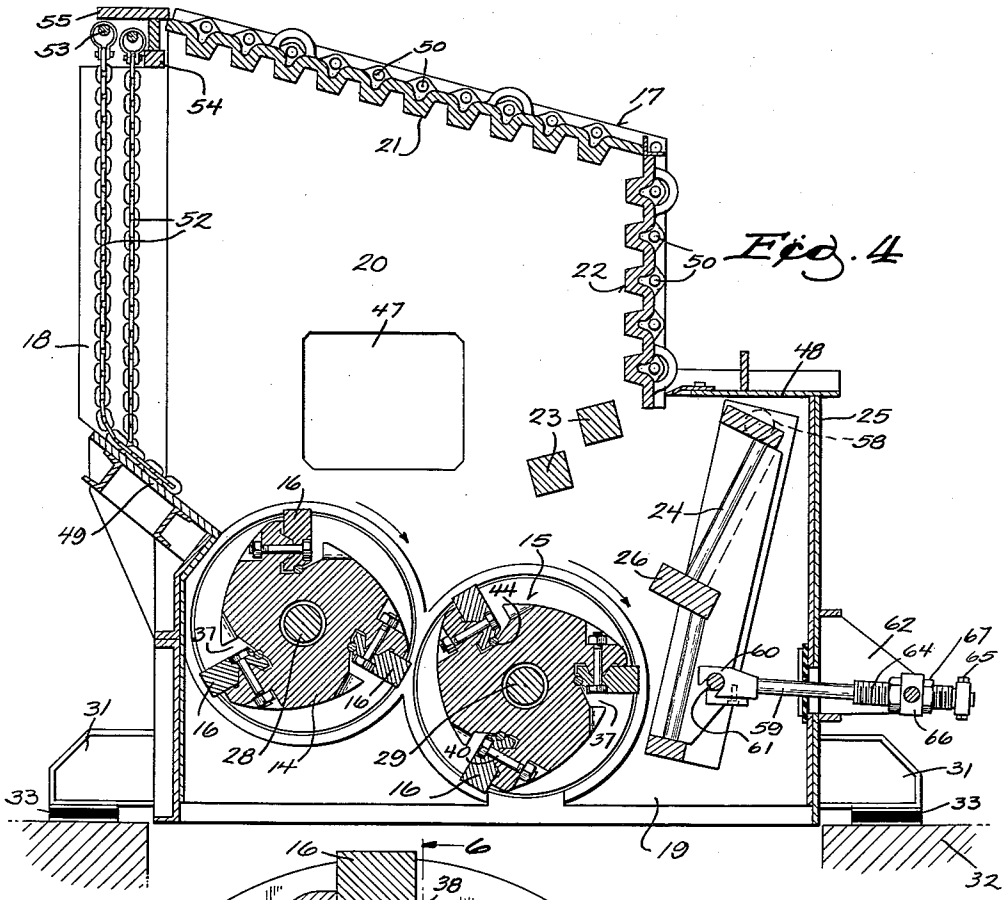



Fig. 4

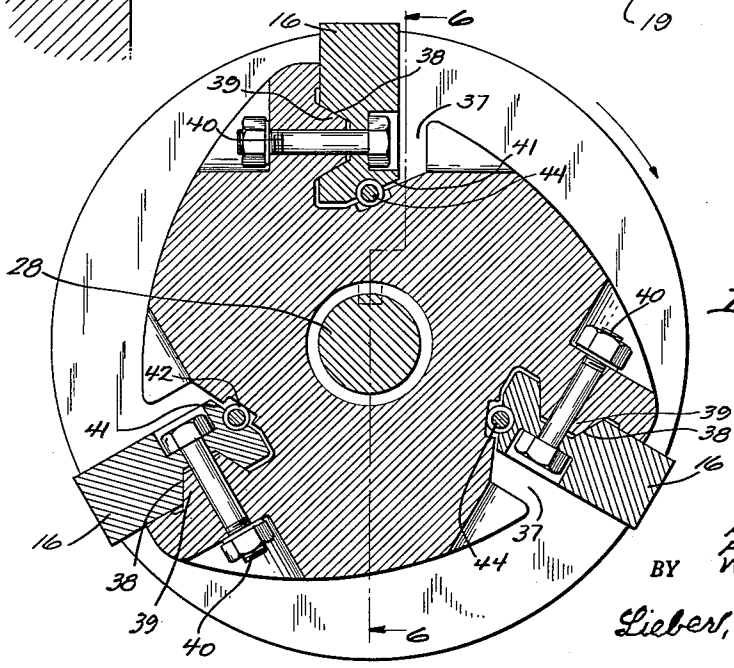



Fig. 5

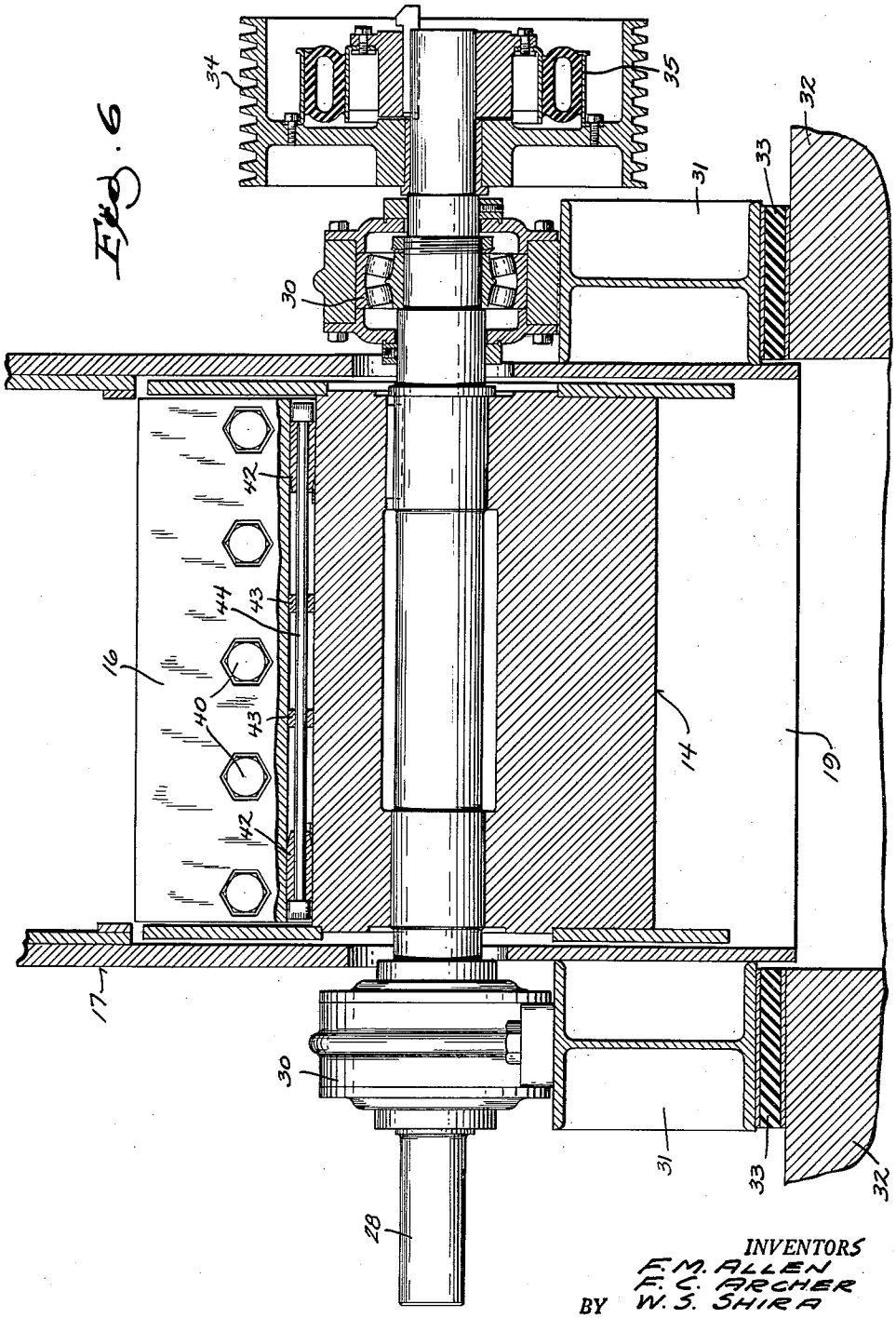
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Fig. 6




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ROTARY IMPACT CRUSHER

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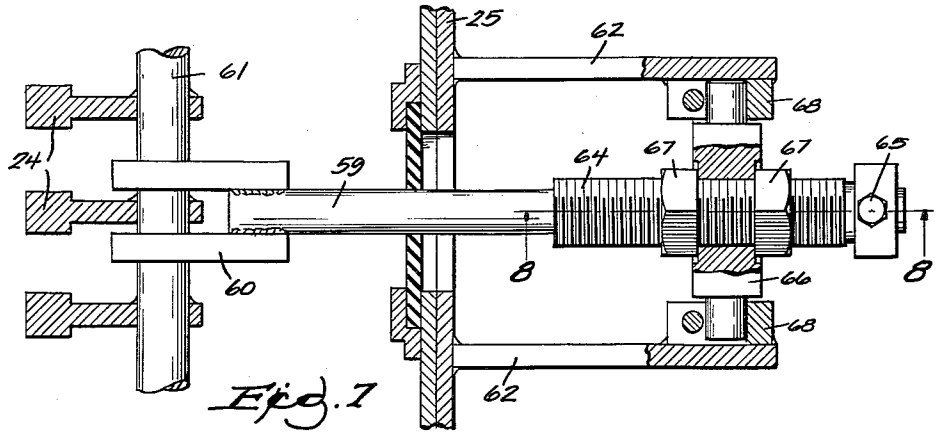



Fig. 7

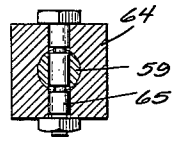



Fig. 9

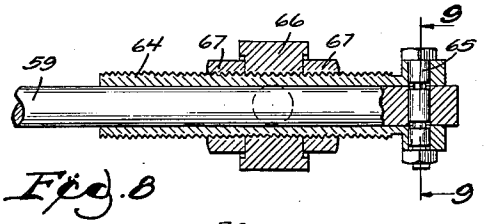



Fig. 8

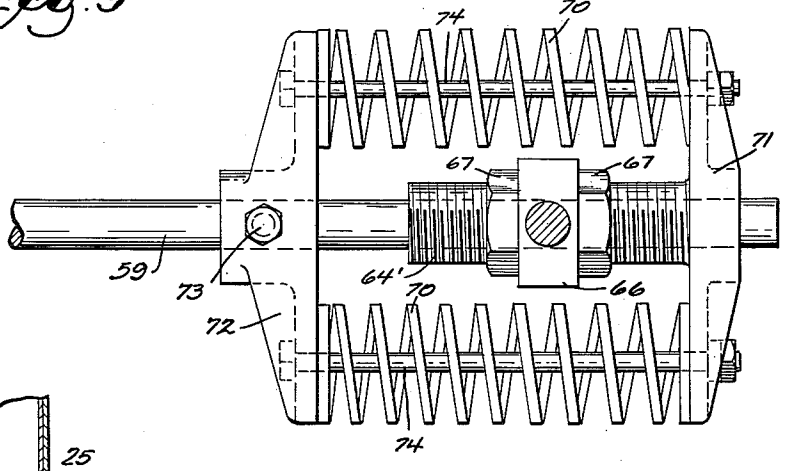



Fig. 10

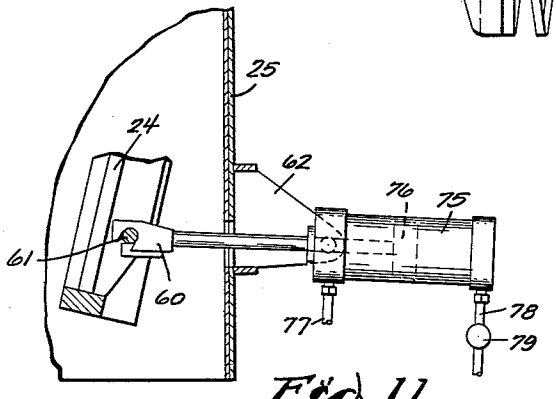



Fig. 11

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# ROTARY IMPACT CRUSHER

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7 Claims. (Cl. 241—32)

The present invention relates generally to improvements in the art of disintegrating hard substances such as rock, ore and the like, and it relates more specifically to improvements in the construction and operation of rotary impact crushers.

The primary object of this invention is to provide an improved rotary impact crusher for hard but brittle material, which is simple and durable in structure and highly effective in use.

Some of the more important specific objects of the invention are as follows:

To provide an improved impact crusher assemblage in which the admitted material is reduced primarily by impact without excessive abrasive or grinding action.

To provide a compact crusher of large capacity wherein bulk frangible material is repeatedly subjected to violent impact in successive stages by several rotors cooperating with each other and with fixed breaker elements properly formed and positioned to effect rapid reduction of oversize product.

To provide a compact crushing unit of large capacity in which smaller particles of coarse and fine mixture of brittle material, are promptly removed from the impact crushing zone so as to permit most efficient reduction of the oversize material with minimum power consumption.

To provide an impact crusher embodying a pair of cooperating impact rotors having hammers revolvable in the same direction about parallel horizontal axes disposed at different elevations, and wherein the higher rotor subjects the entering bulk material to initial crushing impact while the lower rotor cooperates with an improved breaker bar and grid assemblage to effect final crushing and product discharge.

To provide an improved safety device for rotary impact crushers comprising a discharge screening grid which is normally fixed but adjustable to vary the size of the final product, and wherein the adjusting means is operable to automatically release the grid whenever uncrushable material is admitted in order to allow such material to escape from the crushing zone without damaging the machine.

To provide an improved impact crushing unit having rotors and normally fixed breaker parts for repeatedly returning oversize material to the paths of the rotor hammers, and in which such parts may be assembled or dismantled without disturbing the rotors.

To provide an improved breaker and screening grid for a rotary impact crusher, which is pivotally suspended at the top in protective bearings and is also conveniently adjustable and accessible without removing other parts of the unit.

To provide an improved material admitting chain curtain for impact crushers, comprising several staggered rows of chains suspended from the top of the crusher inlet and having the chain suspensions protectively concealed to prevent damage by flying fragments of material being crushed.

To provide an improved durable rotary impact crusher housing having an upper bulk material inlet and an open lower crushed material outlet and which is supported upon shock absorbing material in order to protect concealed or suspended crusher parts against damage.



To provide a housing casing for impact crushers, which is readily internally accessible for inspection of parts without necessitating removal thereof, but in which such parts may be conveniently assembled or removed if desired.

To provide improved rebound or deflector bars for material being crushed by impact within an enclosed zone, which may be readily removed and rotated to present new surfaces for maximum wear.

To provide improved hammer mountings for the rotors of impact crushers, wherein the hammers are normally secured to the rotor by fastening bolts which may be subject to breakage or wear, but will not become detached when such breakage or excessive wear occurs.

These and other more specific objects and advantages of the invention will be apparent from the following detailed description.

A clear conception of the improved structures and of the construction and operation of a typical rotary impact crusher embodying the invention may be had by referring to the drawings accompanying and forming a part of this specification in which like reference characters designate the same or similar parts.

FIGURE 1 is a side elevation of the rotary impact crusher showing the general shape of the housing, the location of the rotors, and the housing support;

FIGURE 2 is an enlarged end view of the crushing unit looking toward the inlet end thereof;

FIGURE 3 is a similarly enlarged opposite end view of the same unit;

FIGURE 4 is a likewise enlarged central vertical section through the machine, taken along the line 4—4 of FIGURE 2;

FIGURE 5 is a further enlarged transverse vertical section through one of the impact rotors of the crusher also taken along the line 4—4 of FIGURE 2;

FIGURE 6 is a similar further enlarged central longitudinal section through the impact rotor taken along the irregular line 6—6 of FIGURE 5;

FIGURE 7 is a likewise enlarged part sectional top view of a discharge grate adjusting assemblage embodying a shear-pin safety release for the grate;

FIGURE 8 is a fragmentary vertical longitudinal central section through the shear pin device of FIGURE 7, taken along the line 8—8;

FIGURE 9 is a transverse vertical section through the same shear pin device, taken along the line 9—9 of FIGURE 8;

FIGURE 10 is an enlarged elevation of a modified spring actuated safety release assemblage for the discharge grate of the impact crusher; and

FIGURE 11 is a fragmentary side view of a further modified hydraulically actuated safety release mechanism for the discharge grate, drawn to a reduced scale.

While the invention has been shown and described as having been specifically applied to a two stage rotary impact crusher, some of the improved features may also be advantageously applied to single rotor and other types of impact crushers; and it is contemplated that specific descriptive terms employed herein be given the broadest possible interpretation consistent with the disclosure.

Referring to the drawings, and especially FIGS. 1 to 4 inclusive, the improved rotary impact crusher shown, comprises in general, a primary rotor 14 rotatable about a horizontal axis; a secondary rotor 15 rotatable about a parallel horizontal axis disposed at a lower elevation than the primary rotor axis; an annular series of impact hammers 16 secured to each of the rotors 14, 15 and being revolvable in the same direction about said axes along annular paths adjoining each other; a sectional housing 17 for the rotors 14, 15 having a front inlet 18 and an unobstructed bottom outlet 19 and forming an

enlarged impact zone 20 above the rotors bounded at the top by a breaker plate 21 extending away from the inlet 18 in a plane approximately parallel to the common plane of both rotors axes, and by an upright breaker plate 22 depending from the lower end of the plate 21; a pair of impact bars 23 fixedly mounted in the housing 17 near the lower end of the plate 22 and above the rotor 15; and a crushed material discharge grid 24 pivotally suspended rearwardly of the bars 23 within a rear offset 25 of the housing 17, and having a breaker bar 26 secured thereto intermediate the ends of the grid bars in proximity to the rotor 15.

The primary rotor 14 is secured to a drive shaft 28 while the secondary rotor 15 is secured to a drive shaft 29, both of which are supported in anti-friction bearings 30 mounted upon beams 31 which coact with the foundation 32 through shock and vibration absorbing pads 33, see FIGS. 1 to 6 inclusive. The two rotors 14, 15 are preferably independently propelled by electric motors or the like drivingly connected to the corresponding ends of the shafts 28, 29 by V-belts coacting with sheaves 34, and these sheaves may be drivingly attached to the adjacent shaft ends by shock absorbing fluid cushioned rotary motion transmitters 35, as shown in FIG. 6. The opposite corresponding ends of the shafts 28, 29 may also be interconnected by motion equalizing pulleys and belts, not shown.

The impact hammers 16 extend entirely across and have their inner ends confined within peripheral recesses 37 formed in the rotor bodies, while their outer ends are heavy and project outwardly beyond these recesses, see FIGS. 5 and 6. The trailing side of each hammer 16 is provided with a V-shaped groove 38 adapted to snugly coact with a V-shaped projection 39 formed on its carrying rotor, and clamping bolts 40 normally hold each hammer firmly in position. The inner end of each hammer 16 is also provided with an inclined surface 41 disposed approximately parallel to the inner surface of the corresponding rotor projection 39, and a pair of end bushings 42 and intermediate collars 43 carried by a rod 44 are interposed between the inner end of each hammer and the bottom of the adjacent groove 38 near the hammer surface 41. These bushings 42 and collars 43 coact with the rotor projections 39 and with the hammers 16 to prevent the latter from flying off of the rotors 14, 15 in case the normal holding bolts 40 become excessively worn and no longer serve their hammer retaining function.

The housing 17 is preferably formed of durable metal and has its opposite sides provided with replaceable wear resisting liners, and this housing may be split along a horizontal plane 46 extending between but in close proximity to the rotor bearings 30 and cooperating therewith so as to permit upward removal of the top section without necessarily disturbing the impact rotors 14, 15, see FIG. 1. This housing 17 is also provided with side and end, and an upper inspection openings normally sealed by covers 47, respectively as shown in FIGS. 1 3 and 4, and with a removable cover 48 for facilitating insertion and removal of the grid 24, and also has an inclined chute 49 for delivery material into the path of the hammers 16 of the primary rotor 14 through the inlet 18 removably mounted upon the housing. The top and rear breaker plates 21, 22 are also formed of wear resistant metal and are provided with rebound serrations, and these rebound plates are also detachably secured to the housing 17 for convenient replacement by means of bolts 50, as depicted in FIG. 4.

When the crusher is operating pieces of fragile material of various sizes admitted to the crushing zone and into the path of the revolving hammers 16 of the rotor 14 along the inlet chute 49 will be projected against the imperforate breaker plates 21, 22 and will rebound toward the rotors 14, 15 and toward the inlet 18 through the zone 20. In order to prevent material from flying out of the inlet 18, a safety curtain comprising two



staggered series of relatively heavy chains 52, is provided as shown in FIGS. 2 and 4. These chains 52 are suspended from their upper ends upon pivot rods 53, and in order to protect these pivotal supports against flying material, the rods 53 are confined behind an apron 54 and beneath a top plate 55 detachably secured to the housing 17 by bolts 56. Since the chains 52 are suspended only from the top and are flexible, they do not interfere with entry of the material to be crushed through the inlet 18.

The normally fixed impact bars 23 which span the crushing zone 20 adjacent to the lower end of the fixed upright breaker plate 22, have polygonal cross-section and are mounted in similarly polygonal sockets in the side liners of the housing 17, so that these bars 23 may be rotated about their longitudinal axes to present new faces to the impact zone 20 as they become worn. These bars 23 are so disposed that reduced material dropping from the upright breaker plate 22 will descend by gravity therebetween, but larger pieces of material striking the bars 23 will be delivered into the revolving hammer paths for further reduction.

The crushed material discharge grid 24 is swingably suspended from pivots 58 mounted in the opposite sides of the rear housing portion 25 beneath the cover 48, and this grid comprises upper and lower screening sections each having a series of spaced bars mounted in a sturdy frame, and the heavy horizontal breaker bar 26 interposed between the adjacent ends of the screen sections and also secured to the grid frame. The discharge side of the grid 24 is in open communication with the lower outlet 19 of the housing 17, and while this grid is normally stationary it may be adjusted relative to the lower rotor 15 about the pivot 58 by means of a rod 59 the forward of which is provided with a hook 60 engaging a pin 61 secured to the grid frame while the opposite rod end is adjustably associated with a safety release device coacting with ears 62 secured to the rear frame section 25, as shown in FIGS. 1, 4, 7 and 11.

As illustrated in FIGS. 7, 8 and 9, this grid adjusting any safety release device comprises an externally threaded sleeve 64 embracing the rod 59 and the extreme outer end of which is connected with the adjacent rod end by a transverse shear pin 65 while its threaded exterior is adjustably connected to a pivot cross-head 66 by nuts 67 coacting with the threads. The opposite ends of the cross-head 66 are pivoted in sockets 68, and by adjusting the cross-head 66 along the sleeve 64 the position of the grid 24 relative to the impact rotor 15 may be varied as desired, whereas the shear pin 65 will be disrupted to permit free rearward swinging of the grid 24 away from the rotor 15 if an unbreakable object such as a shovel tooth becomes jammed between the grid and the hammers 16 of the rotor 15.

The safety release and grid adjusting device has been modified in FIG. 10, by additionally providing a pair of compression springs 70. In this modification the threaded sleeve 64 also embraces the adjusting and release rod 59 and cooperates with nuts 67 and a cross-head 66 pivotally mounted in sockets 68 to effect adjustment of the grid 24 relative to the impact rotor 15, but the outer end of the sleeve 64 has a plate 71 rigidly attached thereto. Another plate 72 is fixedly secured to the medial portion of the rod 59 by a shear-pin 73, and the springs 70 are confined between these plates 71, 72 by bolts 74 which are slidably associated with the plates so as to permit the springs to compress and thereby enable the grid 24 to swing rearwardly away from the rotor 15 whenever an unbreakable object is encountered. The pin 73 of this release assemblage is a shear-pin adapted to be disrupted by abnormal loading.

In FIG. 11 the safety release and adjusting mechanism has been further modified by substituting a fluid pressure motor or jack for the shear-pin, springs and adjusting

sleeve. This fluid pressure actuated device comprises a cylinder 75 having a plunger 76 which is attached to the outer end of the rod 59, slidable therein between displacement chambers connected to a source of fluid under pressure though conduits 77, 78. The forward end of the cylinder 75 is pivotally mounted in sockets formed in the ears 62, and the two displacement chambers should be kept constantly filled with pressure fluid through the conduits 77, 78 while the conduit 78 should also be provided with an automatic pressure release valve 79 adapted to be set to release the fluid from within the rear displacement chamber and to permit the grid 24 to swing rearwardly whenever a pre-determined abnormal pressure is applied thereagainst. By admitting fluid under pressure to either displacement chamber while permitting an equal amount of the fluid to escape from the other, the position of the grid 24 may be readily adjusted as desired.

When the improved rotary impact crusher has been constructed, assembled and properly adjusted as above described, its operation is as follows: Bulk frangible material containing pieces of various sizes may be admitted through the inlet 18 along the inclined chute 49 into the path of the rapidly revolving hammers 16 of the primary rotor 14, and is subjected to violent impact and projected by the heavy hammers through the crushing zone 20 and against the breaker plates 21, 22. Some of this material rebounds from the serrated plates 21, 22 into the path of the hammers 16 of the rotor 14, while other material drops from the upright breaker plate 22 onto the breaker bars 23 and into the hammer path of the secondary lower rotor 15. The rapidly revolving hammers 16 of the secondary rotor 15 project the material deposited thereon against the bars 23 and against the grid 24 and its breaker bar 26. Some of the relatively small pieces of the material admitted to the zone 20 fall directly through the bottom outlet 19, while other such pieces are thrown by the lower rotor 15 through the grid 24 from which they also escape through the outlet 19, and this impact crushing continues until all of the material has been crushed and delivered through this outlet.

During this violent impact action, the rotors 14, 15 are revolving at high speed in the same direction and naturally tend to create considerable jarring and vibration, but the resilient pads 33 coacting with the beams 31, cooperate with the shock absorbers 35 to effectively prevent such disturbances from damaging the rotor shaft bearings 30 and the foundation 32. The curtain of chains 52 which spans the inlet 18, prevents flying material from escaping through this inlet, and the chain suspension pivots 53 are well protected by the guard plates 54, 55. The improved disposition of the primary and secondary rotors 14, 15 insures most effective impact crushing, and reduces to a minimum the percentage of dust by avoiding direct abrasion and resultant rapid wear of coacting crusher elements and by also removing crushed material from the zone 20 as rapidly as possible.

The improved formation and coaction of the impact hammers 16 with the rotor bodies, also prevents these hammers from becoming detached in case the bolts 40 break or become excessively worn; and the adjusting and safety release mechanism which may be applied to the discharge grid 24 positively prevent breakage of parts while permitting convenient variation in the size or mesh of the final product. The rotors 14, 15 are readily accessible for inspection and repair without removing them from the lower housing section, and all other normally concealed elements of the crusher are also conveniently accessible for inspection or renewal. The improved impact crusher has enormous capacity considering its simplicity and size, and can be operated with minimum power consumption due to the flywheel effect produced by the heavy two stage impact rotors. The formation and disposition of the breaker plates 21, 22 and their cooperation with the rotors 14, 15 also insures maximum crushing efficiency and the production of uniform size product. The location of the grid 24 within a rear offset 25 of the housing 17 and the provision of the cover 48 at the top of this offset is also important in order to permit convenient installation or removal of this relatively heavy grid whenever necessary, with the aid of an overhead crane or the like.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

We claim:

1. A rotary impact crusher comprising, cooperating rotors each having a series of peripheral grooves extending throughout its length and being provided with a rigid V-shaped projection extending into each groove, a hammer mounted in each of said grooves and having a V-shaped recess coacting with the adjacent rotor projection, means for detachably attaching each of said hammers to its rotor with its recess in snug engagement with the adjacent projection, and means interposed between the inner end of each hammer and the bottom of the receiving groove for preventing the hammer from becoming detached from the rotor when the hammer attaching means becomes disrupted.

2. A rotary impact crusher comprising, a rotor having peripheral grooves extending throughout its length each provided with a rigid projection extending laterally into the groove, a hammer mounted within each of said grooves and having a recess snugly fitting the adjacent projection, bolts extending through each hammer and through the adjoining projection for normally holding the hammer attached to the rotor, and means interposed between the inner end of each hammer and the bottom of its receiving groove for forcing the hammer into intimate engagement with an inner face of the adjacent rotor projection.

3. A rotary impact crusher comprising, cooperating upper and lower rotors having peripheral impact hammers revolvable in the same direction about parallel horizontal axes disposed at different elevations, a housing for said rotors forming an unobstructed impact zone above the hammer paths and being bounded above said zone by a rectilinear breaker plate disposed parallel to the common plane of the rotor axes and by another rectilinear breaker plate depending from the lower end of said inclined plate, several stationary breaker bars spanning said housing beneath and laterally of said zone and between the lower end of said depending plate and the path of the hammers of the lower rotor, and an approximately upright material discharge grid pivotally suspended from said housing laterally of said stationary bars and of said lower rotor and having thereon upper and lower grid sections separated by another breaker bar.

4. A rotary impact crusher comprising, a rotor having peripheral grooves extending throughout its length each provided with a rigid V-shaped projection extending into the adjacent groove in the direction of rotation of the rotor, a hammer confined within each of said grooves and having one side provided with a V-shaped recess snugly fitting the adjacent projection while its opposite side is bounded by a plane radial surface, holding bolts for each hammer passing therethrough and through the adjacent V-shaped projection of the rotor, and wedges interposed between the opposite ends of each hammer at the bottom of the adjacent groove.

5. A rotary impact crusher comprising, a housing forming an upper unobstructed impact chamber and having an inlet at one side and a reduced off-set portion at its opposite side while its bottom is open, an impact rotor rotatably confined within said housing beneath said chamber and entirely between said inlet and said off-set portion, an approximately upright impact grid having upper and lower sections and being pivotally suspended at its upper end within said housing off-set portion in

close proximity to said rotor, a heavy breaker bar secured to said grid between said sections and projecting therefrom toward said rotor, and a top closure for said housing off-set portion for facilitating insertion and removal of said grid vertically relative to the housing interior.

6. A rotary impact crusher according to claim 5, wherein said grid is provided with adjustment means connected thereto remote from its pivotal suspension means and below the breaker bar for swinging the same to various positions of adjustment relative to the rotor with said adjustment means being provided with safety release means for permitting the grid to swing away from the rotor beyond its adjusted position when uncrushable material is admitted to said zone.



7. A rotary impact crusher according to claim 5, wherein a pair of spaced breaker bars span the chamber between its juncture with the off-set portion and the rotor.

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