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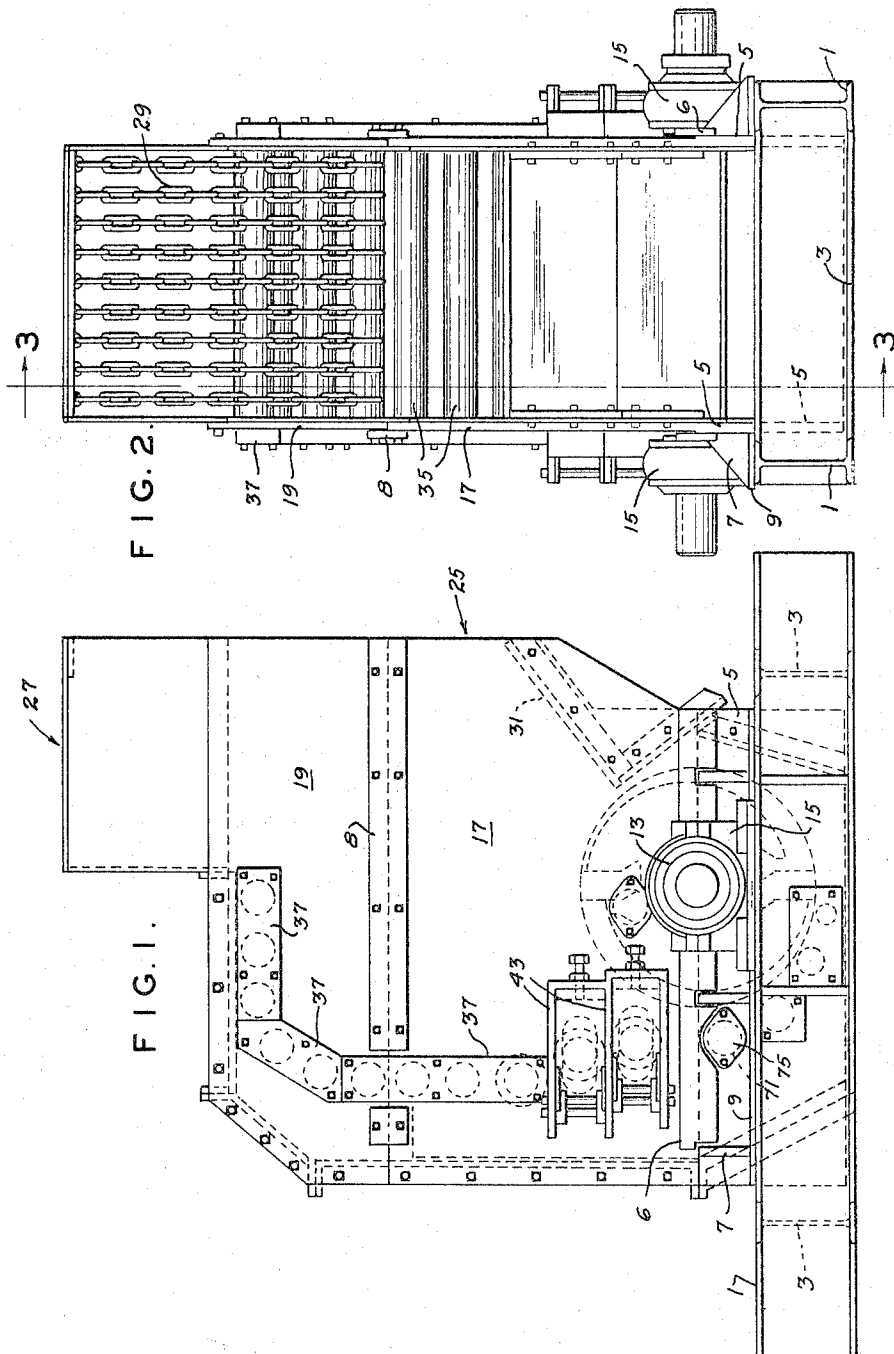
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3,295,773

CRUSHER

Original Filed Aug. 31, 1959

3 Sheets-Sheet 1



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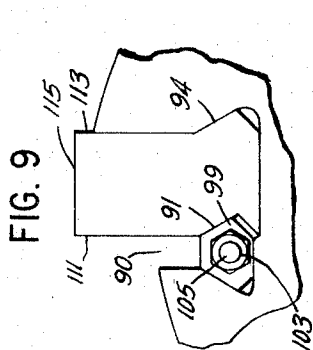
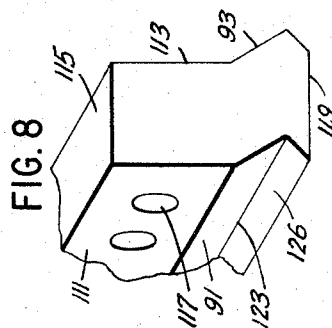
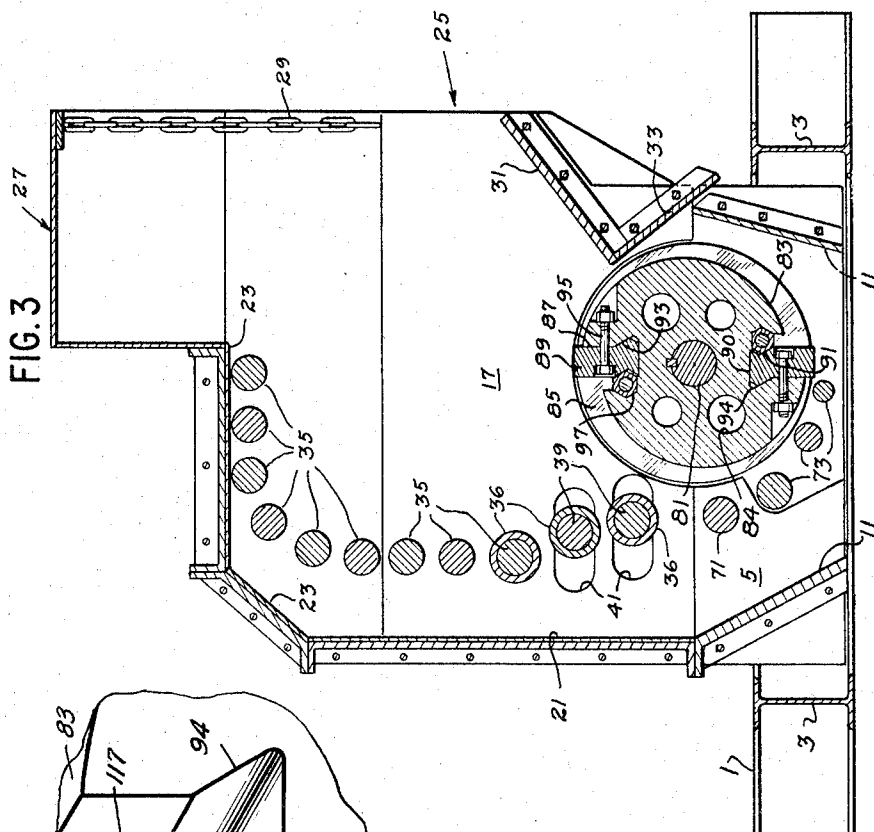
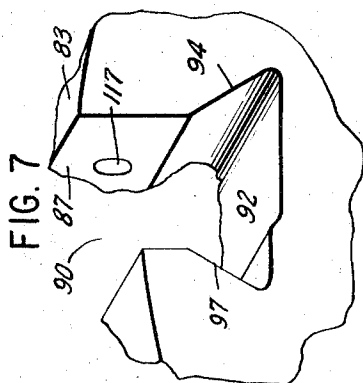
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

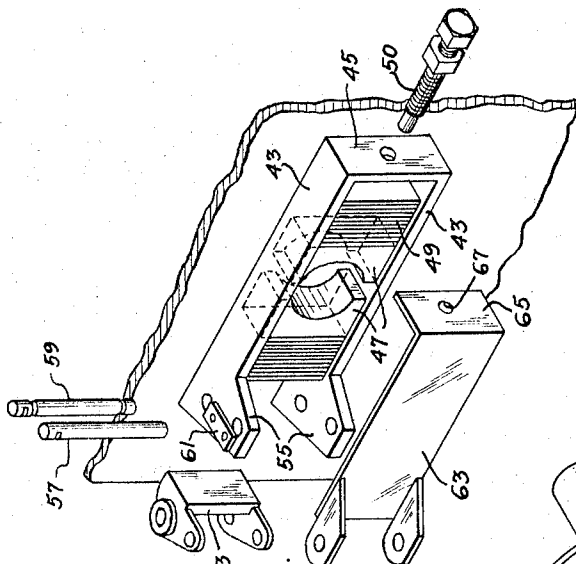


FIG. 4.

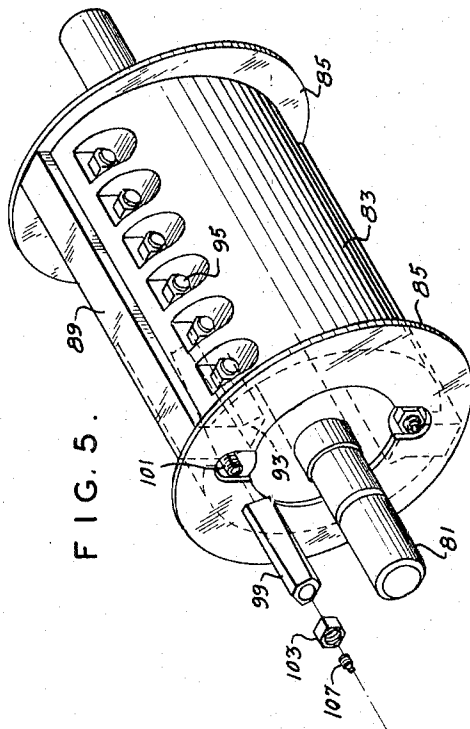


FIG. 5.

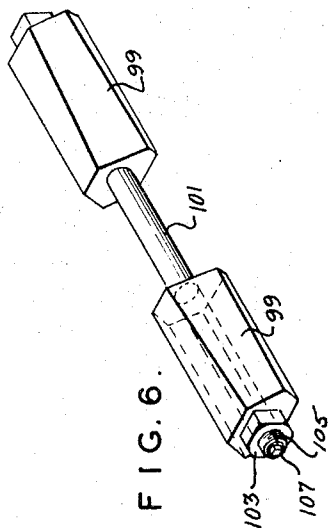


FIG. 6.

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3,295,773
CRUSHER

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Application Aug. 26, 1963, Ser. No. 305,025, now Patent No. 3,202,368, dated Aug. 24, 1965, which is a continuation of application Ser. No. 837,053, Aug. 31, 1959. Divided and this application June 30, 1965, Ser. No. 468,261

12 Claims. (Cl. 241—191)

This invention relates generally to crushers, and more particularly to impact type single-rotor crushers; and this is a division of my co-pending application Serial No. 305,025, filed August 26, 1963, now U.S. 3,202,368, said application forming a continuation of my previous application Serial No. 837,053, filed August 31, 1959, and now abandoned.

Among the several objects of the invention will be noted the provision of a single-rotor crusher of rugged economical construction; the provision of a crusher having a hammer plate removably secured to a rotor in such fashion as to be strongly held during normal operation; the provision of a crusher having breaker bars arranged for both primary and secondary crushing; the provision of a crusher wherein certain breaker bars are adjustable yet are adapted to yield in the event of a jam but without danger to adjacent personnel or machinery; and the provision of a crusher having improved breaker action.

Although the apparatus will be described in detail in connection with the drawings, briefly, the crusher of this invention comprises a housing with side, back and top walls defining a front feed entrance and a bottom discharge opening. Breaker bars extend horizontally between the side walls in parallel vertically-spaced relationship adjacent the top and back wall, there being a space between the breaker bars and back wall through which the reduced product may pass. The breaker bars in the upper portions of the machine are in relatively fixed positions and are conveniently mounted merely in openings cut in the side walls through which the bar ends project, the bars then being held against endwise displacement, as by collars or by elongate plates which are bolted to the outer surface of the side walls. Adjustable breaker bars are mounted in the back lower part of the machine horizontally opposite an inclined feed plate at the front of the machine, and the rotor is arranged so as to project above the line between the lower adjustable bar and the lower part of the feed plate, this being critical in avoiding "bridging over" of the material as it is fed into the crusher.

In mounting the adjustable bars, horizontal slots are cut through the side walls to accommodate the bar ends, and U-shaped brackets are fastened to the side walls so that the legs of a bracket extend rearwardly above and below the adjacent slot. The end of a breaker bar is then held between a pair of support blocks suitably recessed to embrace the end of the bar, and the blocks are slidably mounted between the bracket legs.

Each bar-supporting block is backed up by a set of shims, the front set being held by a lock-bolt threaded through the front of the bracket and the back set of shims being held by a plate or block hinged on a pivot pin in the back of the bracket. This back plate is releasably secured by a shear pin, but can swing back when the shear pin breaks, as might occur during a jam. The breaker bars are adjusted toward or away from the rotor by adding or removing shims. It will be apparent, however, that the likelihood of flying parts is minimized. In fact, it is desirable to provide a cover plate supported from the pivot pin to extend forwardly over the shims, the front of the cover having an intumed lip secured by the lock bolt.

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The rotor is a solid somewhat cylindrical member actually having the exterior shape produced as if a true cylinder were slit along a diameter and the two parts then shifted a slight distance so as to provide a pair of opposed hammer shoulders at the periphery. A hammer-receiving slot having a substantially dove-tail cross section is formed immediately in front of each shoulder to support a narrow hammer plate having a radially, inner front beveled corner and a radially inner back lip. The lip fits within a suitable recessed portion in the back part of the hammer-receiving slot of the rotor, while a wedge element fits within a similar recessed portion in the forward part of the hammer slot, with the result that the hammer plate is securely locked within the rotor. If desired, the hammer plate may also be secured by bolts extending peripherally through the plate and rotor.

The wedge system involves a pair of axially movable wedge parts adapted to be drawn toward one another on a rod extending lengthwise of the rotor adjacent the inner front beveled portion of the hammer plate. One end of the rod is threaded to receive a nut for forcing the wedges toward one another, and this threaded end is further slit and axially tapped to accommodate a locking plug, which tends to expand the bifurcated ends of the draw rod against the nut.

A further feature of the invention is the provision of a readily removable breaker bar mounted in the lower part of the rotor. With this arrangement, the machine is adaptable for both primary and secondary crushing, the removable bar being drawn out for primary crushing and being inserted for secondary crushing. The removable bar fits within holes in the side walls and is secured by a removable end cover plate fastened to the exterior side walls.

The side walls of the machine are constructed in separable sections of diminishing thickness in the upward direction, thereby providing economy and wear resistance. The separable sections also permit the top to be lowered for secondary crushing.

Other features of the invention will be in part apparent from and in part pointed out in the following detail description taken in connection with the accompanying drawings, in which:

FIG. 1 is a side elevation of a crusher embodying the invention;

FIG. 2 is a front elevation of the crusher shown in FIG. 1;

FIG. 3 is a vertical section through the crusher;

FIG. 4 is an exploded perspective view of the means for holding an adjustable breaker bar;

FIG. 5 is an exploded perspective view of the rotor;

FIG. 6 is an exploded perspective view of the hammer-locking wedge elements;

FIGURE 7 is an enlarged perspective end view of a portion of one of the hammer-receiving slots;

FIGURE 8 is a partial perspective view of one of the hammers; and

FIGURE 9 is an enlarged end view of a hammer locked in the slot.

Referring to the drawings, the main base of the machine comprises a pair of I-beams 1 extending along opposite sides of the housing and a pair of transverse beams 3 extending across the front and back of the machine. Lower side plates 5 are mounted immediately inside of the longitudinal base members 1 and are secured thereto by triangular gusset plates 7 fastened to horizontal plates 9 which rest upon the side base members 1. The lower discharge of the crusher is defined by a pair of inclined front and back plates 11 which span the space between the side plates 5 and are secured thereto. The rotor bearings 13 are suitably supported upon the longitudinal base members 1, as by pillow blocks 15.

The side walls of the housing are further defined by intermediate plates 17 resting upon the lower plates 5 and secured by strips 6. Upper plates 19 secured by strips 8 complete the side walls. A back wall 21 fastened between the side wall sections 17 extends upwardly from the back discharge plate 11, and top-forming walls 23 fastened between side sections 19 extend across the back upper portion of the housing. The front 25 of the housing is opened for entry of the rock, and an open front hood 27 is mounted on the upper front portion of the housing so as to provide a larger feed entrance. It will be noted in FIG. 2 that the thickness of the side wall plates diminishes in the upward direction, hence the side wall structure formed from a multiplicity of side plates is advantageous in achieving an economical construction consistent with the strength requirements of a crusher, wherein the greater wear is at the lower portion adjacent the rotor. Also, the several side sections permit adjustment in the height of the machine, as by replacement of side sections at the upper part of the machine. Chains 29 may be hung from the top of the hood 27, as illustrated in FIG. 2, the rock being fed between the lower ends of the chains and the top of an inclined feed plate 31. The chains permit large rock to enter the machine while permitting the smaller rocks from being thrown outwardly during the crushing operation.

The location of the feed plate 31 with respect to the rotor and the primary breaker bars is important. The top of the feed plate may be from thirty to forty-five inches above the axis of the rotor, depending upon the size of the crusher, and the plate inclines downwardly close to the periphery of the rotor at an angle such as to intersect with a point slightly above the axis of the rotor. The horizontal distance between the axis of the rotor and the front edge of the feed plate might be three to five feet, depending upon the size of the crusher. Also, the space below the inner edge of the feed plate may be closed off with a plate 33 extending between the side walls of the housing, the plate 33 extending from the inner edge of the feed plate 31 forwardly and downwardly at approximately a right angle with respect to the feed plate and terminating adjacent the upper edge of the front discharge plate 11.

The rock is thrown by the rotor against horizontal breaker bars mounted in spaced parallel relationship to span the side walls of the housing adjacent the top and back walls of the machine but in spaced relationship from the walls, thereby to provide a chute for the small product to fall into the discharge outlet. The upper breaker bars 35 are fixed within the machine at predetermined positions. In accordance with this invention, the breaker bars 35 are rod-like members which extend through slightly larger openings in the side plates 17 and 19. The breaker bars are of a length such that they project into the side walls and are thereby held directly by the side walls, but the portion of a bar between the side walls may support a hardened wear sleeve. End closure plates 37 are shown to be bolted or otherwise fastened to the outer surface of the side walls to prevent endwise displacement of the breaker bars.

It will be noted that the upper fixed breaker bars 35 extend downwardly to a line opposite the upper front portion of the feed plate 31. A pair of relatively adjustable breaker bars 39 with wear sleeves 36 are then mounted in the space horizontally opposite from the feed plate 31, and these breaker bars 39 are also mounted so as to have a shear-pin releasing action, thereby avoiding damage in the event that an unduly large and hard rock or other item tends to be jammed between the rotor and lower breaker bars 39.

The manner of supporting the adjustable breaker bars is one of the features of this invention. A generally horizontally elongate slot 41 is cut in each side plate 17 for each breaker bar 39, and a U-shaped stirrup bracket is then fastened to the side wall so that the legs

43 of the stirrup or bracket project rearwardly on opposite sides of the slot. The bracket opens in the rearward direction and is closed by a front plate 45. The breaker bar 39 is then held within a bearing-like block or blocks 47 which are horizontally movable between the legs 43 of the stirrup. The blocks 47, in turn, are adjustable horizontally by means of shims 49 backing up the breaker-supporting blocks both at the front and back thereof. The front set of shims is held by a lock bolt 50 which extends through a threaded opening 51 in the front closure wall 41 of the bracket, whereas the back set of shims is held by a pivotally-supported shear-pin block 53. It will be noted that the back portions 55 of the stirrup bracket project outwardly from the side wall of the housing so as to support a pivot pin 57 in spaced relationship from the side wall. The shear-pin block then extends inwardly from the pivot pin 57 at right angles to the side wall so as to hold the back shim 47 and is itself secured by an inner shear pin 59. A keeper plate 61 may hold both the pivot pin and shear pin within the stirrup bracket. Finally, a cover plate 63 is also secured upon the pivot pin 57 to extend forwardly over the shims 49 and supporting blocks 47. An inwardly directed flange 65 extends from the front of the cover plate within the stirrup bracket and is secured by the lock bolt 50, there being a suitably large aperture 67 in the flange 65 through which the lock bolt may project.

The advantage with this arrangement is that it not only permits adjustment of the breaker bar positions by removing or adding shims, but also protects the apparatus by releasing the breaker bar through rupture of the shear pin and further encloses the flying parts so that bystanders or adjacent equipment will not be injured. The forces developed when a shear pin breaks are so great that the parts tend to fly outwardly at considerable velocity and could injure or damage personnel or equipment nearby, if not secured to the crusher or suitably enclosed.

The crusher of this invention further includes another breaker bar 71 mounted slightly below the horizontal axis of the rotor, which breaker bar 71 is removable, so as to permit the crusher to be used for both primary and secondary crushing. The bar 71 is removed during primary crushing and is inserted for secondary crushing or reduction of the rock to relatively small size. Deflector breaker bars 73 may then be located below the bar 71 adjacent the periphery of the rotor so as to screen out material and prevent rock from being carried back around to the feed entrance of the machine. The breaker bar 71 is secured in the same fashion as the breaker bars 35, there being an end plate 75 which is bolted to the side wall 5 to prevent endwise displacement, the bar otherwise being held by projecting into or through close-fitting openings in the side wall plates 5.

The rotor of this crusher is positioned so as to project upwardly above a line extending generally horizontally between the lower part of the feed plate 31 and the lower adjustable breaker bar 39. This arrangement is significant in preventing "bridge over" within the crusher, a condition which develops when the rock forms an arch within the crusher so as to prevent normal feed against the rotor and generally stop the flow of material through the machine. When the rotor projects upwardly, as shown in FIGS. 1 and 3, it tends to break up any such bridge-over arch before it can develop into a problem.

The rotor shaft 81 is supported in the bearings 13 and the rotor 83 is a solid casting which is secured on and keyed to the shaft. Rotor rings 85 may be attached to the ends of the rotor itself. Although the rotor is a solid casting with weight-reducing holes 84, it is not truly cylindric, but rather has a shape that would be produced if a cylinder were sliced diametrically and the two halves slipped on the diameter so as to provide radial faces or

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shoulders 87 on opposite sides. The hammers 89 are then secured against the shoulders 87.

As seen in FIGURE 7, the hammer-receiving slot 90 is of substantially dove-tail cross section with the flared or undercut portions 94, 97 of the dove-tail extending radially inwardly toward the bottom 92 of the slot, and the constriction of the dove-tail extending radially outward of said flared portions.

Referring now to FIGURE 8, it can be seen that each of the hammers comprises an elongate narrow plate of hard-wearing material having a relatively flat active face 111 adapted to contact the rock, a trailing surface 113 generally parallel to said active face, a top 115, and base 119. A plurality of bolt-receiving apertures 117 extend through the hammer. The relatively planar active face of the hammer extends down toward the base 119 where it is intersected by a pair of beveled surfaces 91, 126 co-operating to form a V-shaped recess, the valley 123 of this recess lying generally behind the leading or active face 111 of the hammer and radially outside of the base 119. Thus, the portion of the hammer between the beveled surface 126 and the base 119 substantially leads the valley 123. The radially inner back portion of the hammer forms a rearwardly projecting lip 93 extending toward the base 119. As seen in FIGURE 9, the portion of the hammer that is disposed within the slot 90 is especially shaped to cooperate with the slot and with certain wedge members, to be hereinafter described, to lock the hammer in place.

When the hammers are assembled and locked into place, it can be seen that the major axes of the two hammers are located on the diameter of the rotor and the active face of the hammers lead the diameter. The valley 123 of the V-shaped recess in the hammer is located radially inwardly of the constriction of the rotor slot. The wedge member is disposed entirely in the space between the valley of said recess and the overlapping portion of the rotor defining the leading undercut portion 94 of the slot. The beveled surface 126 of the hammer underlaps the trailing side of said wedge.

The wedge members force the lip 93 rearwardly into the rear undercut portion 94 of the rotor so as to lock the hammer against radial displacement. In addition, bolts 95 may extend through the hammer and rotor so as to provide a further means of securing the hammer, but the wedge and lip lock is the primary means of holding the hammer within the rotor.

The wedge elements are accommodated completely within the front undercut portion 97 extending across the front of slot 90 and the rotor end rings 85 are also cut away at opposite the ends of this slot 90 so as to permit adjustment of the wedge action. A pair of elongate tapering wedge elements 99 telescope over the draw rod 101, and each wedge element is shaped so as to have larger cross sections in the direction outwardly or endwise of the rotor. When the wedge elements 99 are then drawn toward one another on the draw rod, they wedge the hammer firmly against the rear undercut portion 94 of the rotor slot. One end of the draw rod 101 is threaded to receive a nut 103 by means of which the wedges are drawn inwardly. It is desirable, however, to provide a locking arrangement for the nut 103, and such a lock is conveniently provided by slitting the threaded end of the draw rod at 105 and by providing a tapped hole in the end of the rod for accommodating a pipe plug 107. After adjustment of the nut 103, the pipe plug 107 is screwed in to expand the bifurcated ends of the rod and lock the nut 103 securely thereon against loosening under the forces of vibration.

From the foregoing description, it is apparent that those skilled in the art will understand the structure, function and mode of operation of the invention herein disclosed, and appreciate the advantages thereof. Although one embodiment has been disclosed in detail, it is to be understood that the invention is not limited thereto, but the

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drawings and description thereof are to be understood as being merely illustrative.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. In a rock crusher having a rotatably mounted rotor, unitary impact hammers disposed in slots extending lengthwise across the periphery of the rotor, and wedging means leading said hammers and adapted to lock them in place, the improvement residing in said slot having a substantially dove-tail cross section, the portion of said hammer within said slot conforming to the rear tapered wall of said dove-tail, the wedging means conforming to the front tapered wall of said slot and disposed completely within said slot, and means for drawing said wedging means axially inwardly from the end of the rotor toward one another to urge the hammer tightly against the rear tapered wall and to lock the hammer within the slot.

2. The rock crusher according to claim 1 including auxiliary bolt means for further securing each of said hammers to said rotor.

3. A rock crusher as set forth in claim 1 wherein said wedging means includes a pair of axially movable wedge elements having their larger cross section in the direction endwise of the rotor and a draw rod extending from end to end of the rotor through said wedge element, and the means for drawing the wedge elements toward one another comprises a bolt threaded on one end of said draw rod.

4. A crusher as set forth in claim 3 wherein the threaded end of said draw rod is split and provided with a tap hole, and a threaded plug is adapted to be threaded into said tap hole to expand the end of said draw rod into tight engagement with the surrounding nut.

5. In the crusher as set forth in claim 4, said rotor provided with a pair of diametrically opposed hammer-receiving slots.

6. In a single rotor, two hammer impact crusher wherein removable unitary hammers are mounted with their respective major axes located on a diameter of the rotor and with their active faces leading said diameter, said rotor having hammer-receiving slots extending inwardly from the circumferential periphery of the rotor, said slots being of substantially dove-tail cross section with the leading and trailing flared portions of the dove-tail located radially inwardly of the constricted portion of said dove tail,

(A) Said hammers each having

(1) a rearwardly projecting lip radially inwardly of the face, trailing said diameter and adapted to interfit with the trailing flared portion of the dove-tail slot, and

(2) an axially extending recess intermediate said active face and the base of the hammer, said recess being located radially inwardly of the leading side of said slot constriction,

(B) a pair of axially movable wedge members each having its larger cross section in the direction endwise of the rotor, disposed entirely in the space defined by said hammer recess, the leading corner of the flare, and the bottom of said slot, and

(C) means to urge said wedge elements axially toward one another to lock said hammer in place.

7. The improvement according to claim 6 including auxiliary bolt means for further securing each of said hammers to said rotor.

8. In a single rotor, two hammer rock crusher, the improvement comprising:

(A) a slot in the rotor extending across its cylindrical surface parallel to the axis thereof, said slot having a front side, a bottom, and a back side, said front side having an undercut wedge-receiving portion intermediate the bottom of the slot and the cylindrical surface of the rotor, and extending the full width of the rotor, said back side having an abutment shoulder intersecting the rotor surface and a beveled surface

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forming a rear undercut portion joining said shoulder with the bottom of the slot,

- (B) a hammer, comprising an elongated narrow plate disposed in said slot and comprising a pair of generally parallel surfaces consisting of an active face and a trailing surface rearwardly thereof and in abutting relationship with the shoulder of said slot, a top surface connecting said two generally parallel surfaces, a base disposed in proximity to the bottom surface of said slot, said trailing surface and said base connected by a rearwardly projecting lip confined within said rear undercut portion of said slot, the active face of the hammer separated from the base thereof by a V-shaped recess located radially within the undercut front portion of said slot, the valley of said recess trailing said active face,

- (C) a pair of tapered elongated wedges disposed totally within said slot, each adapted to be inserted from each end of the rotor into the slot to secure the hammer therein, including:

- (1) a bottom surface adapted to contact the bottom surface of the slot,
- (2) a second surface adapted to contact the front undercut portion of said slot,
- (3) a third surface adapted to engage the V-shaped recess of said hammer, and
- (4) an annulus extending the length of each elongated wedge,

said wedges increasing in cross section as they extend from the middle of the rotor toward the ends thereof,

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- (D) an elongated threaded rod passing through the annuli of said wedges in said slot, and

- (E) a nut threaded on said rod to draw said wedges toward one another.

9. The crusher according to claim 8 wherein said shoulder intersects the surface of the rotor at a point more remote from the axis of the rotor than the line of intersection between the surface of the rotor and the front side of the slot.

10. The crusher according to claim 9 wherein the threaded end of said rod is split and provided with a tap hole, and a threaded plug is adapted to be threaded into said tap hole to expand the end of the draw rod into tight engagement with the surrounding nut.

11. The mechanism of claim 10 wherein a portion of the hammer base leads the valley of said V-shaped hammer recess.

12. The crusher according to claim 11 including auxiliary bolt means for securing said hammer to the shoulder of the rotor.

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