This invention relates to rotary impact hammers used for crushing rock and the like and in particular to an improved construction for locking the hammers to the rotor body.

Impact breakers or hammer mills typically include one or more massive rotors carrying a plurality of hammer members projecting radially therefrom. Material to be crushed is delivered into the path of the rotating hammer members which strike the material with sufficient force to shatter it and/or throw it against various stationary breaking surfaces which are fixed within a housing enclosing the rotor. The hammer members are often in the form of bars secured in longitudinal channels in the periphery of the rotor body, and a variety of bar shapes and wedge elements have been suggested for obtaining a firm mounting which will not loosen during operation of the rotor. Some of the constructions which have been suggested are fully described in Patent Nos. 2,714,018; 2,378,475; 2,558,943; 2,747,803 and 2,767,928.

It is the primary object of the present invention to provide an impact hammer rotor having a simple and effective construction which rigidly secures a hammer member in a channel in the rotor body and which permits easy removal and insertion of the hammer members in a generally radial direction.

It is a further object of the invention to provide an impact hammer of the above type in which the front and rear surfaces of the hammer member cooperate with the sides of the channel in such a manner that the hammer member may be hooked into the channel but may not be removed therefrom by linear movement.

It is a still further object to provide an impact hammer rotor of the above type in which the rear surface of the bar has a generally convex portion and the front surface has a generally concave portion and in which the walls of the channel engage the front and rear surfaces.

These and other objects and advantages will become apparent from the following detailed description taken with the drawings in which:

FIGURE 1 is a front elevation view of an impact hammer rotor embodying the principles of the present invention;

FIGURE 2 is a sectional view taken on the line 2—2 of FIGURE 1;

FIGURE 3 is an exploded view in perspective of part of the rotor of FIGURE 1;

FIGURE 4 is a perspective view of the hammer bar of FIGURE 3 in a different position;

FIGURE 5 is a fragmentary view on an enlarged scale of part of FIGURE 2;

FIGURE 6 is a top plan view of a tightening wedge used to lock the hammer bar in a channel in the rotor body;

FIGURE 7 is an end elevation view of the wedge looking from the left of FIGURE 6.

Referring to FIGURES 1-7 it is seen that a rotor 10 illustrating the principles of the present invention includes, as major components, a rotor body 12 having three equippaced longitudinal channels 14 in the periphery thereof, a hammer bar 16 in each channel 14, and end wedges 18 for locking the hammer bars 16 in the channels 14. As seen in FIGURES 1 and 2 the rotor body 12 includes a plurality of stacked disks 20 having three generally spiral surfaced outward extensions 22 each of which terminates in a flat forward face 24 which lies in a plane parallel to the rotational axis of the body 12. As is conventional in the art, the disks 20 are secured together as by welding and are rigidly mounted on a shaft 26 passing axially therethrough as by pinning the end disks to the shaft 26. The rotor 12 may also be provided with end rings 28 secured to the end disk as by welding. The periphery of the disks 20 may be provided with spaced, staggered hard-surfaced plates 30 as is conventional in the art. The disks themselves may be constructed of mild carbon steel and the wedges 18 of high carbon steel.

According to one aspect of the invention the hammer bars 16 and the channels 14 are constructed to permit the hammer bars to be inserted into the channels by swinging or hooking the lower portion of the former into engagement with the walls of the latter. The embodiment illustrated in the drawings each hammer bar 16 is an elongated bar having a body or impact portion 32 of generally rectangular transverse cross section and a foot or retainer portion 34 which cooperates with the side walls of the channel 14 in a manner hereinafter described in detail. The body portion 32 has an outer terminal surface 36, and flat, parallel front and rear surfaces 38 and 40, respectively. The foot portion 34 has a generally convex rear surface which merges with the rear surface 40 of the body portion 32 and a generally concave front surface which intersects the front surface 38 of the body portion 32. The bottom surface 42 of the foot portion 34 is parallel to the outer terminal surface 36 of the body portion 32 and defines, with the forward concave front surface, a lip 44 which eliminates friction between the front portion 30 of the body portion 32 to terminate in the front surface 46 which is parallel to surface 38. As shown, the hammer bar 16 is provided with two elongated, cored pockets 48 in the rear or non-wearing surface 40 of the body portion 32 for economy and with three smaller cored pockets 50 in the rear convex surface of the foot portion 34. The bar 16 is also shown as having two spaced cut-out portions 52 in the foot portion 34 so that in the particular embodiment illustrated there are three foot portions.

As best seen in FIGURES 3, 4 and 5 the generally convex rear surface of the foot portion 34 is formed essentially by two forwardly extending, intersecting surfaces 54 and 56 which lie in planes parallel to the longitudinal axis of the bar 16. The upper planar surface 54 is the rear surface 40 of the body portion 32 and the lower planar surface 56 also intersects the bottom surface 42 of the foot portion 34. Each end 56a of the lower planar surface 56 is inclined forwardly along its entire length and, in addition, is inclined outwardly at its ends to form the two modified surfaces 56a which cooperates with the two wedges 18 in the assembled rotor 10. An intersection of the surface 56 with each of the surfaces 56a does not actually occur in the illustrated embodiment because of the cut-outs 52 but, in the absence of the cut-outs 52, such intersections would occur along the inner extremities 56b of the surfaces 56a.

The generally concave front surface of the foot portion 34 is formed by three planar surfaces 58, 60 and 62 which lie in planes parallel to the longitudinal axis of the bar 16. The upper surface 58 intersects the impact surface 38 of the body portion 32 and is inclined rearwardly and downwardly. The lower surface 62 is parallel to the upper surface 36 of the body portion 32 and defines the upper surface of the lip 44. The intermediate surface 60 inter-
sects the surfaces 58 and 62 and is inclined forwardly and downwardly.

The channels 14 in which the hammer bars 16 are locked are formed radially in the periphery of the rotor body 12 and extend parallel to the axis of rotation. Each channel is defined by a generally concave rear wall, a planar front channel wall, and a generally convex front wall. By the particular construction illustrated, the forward face 24 of one of the spiral extensions 22 forms a part of the rear wall of each of the channels 14, but it will be understood that the channel construction of the invention does not depend on the presence of the spiral extensions 22. Each rear wall of each of the channels 14 includes a planar surface adapted to back up the rear surface 40 of a hammer bar 16 and to absorb the shock of impact between the hammer bar 16 and the material being crushed. This surface should extend generally inwardly from the periphery of the rotor body toward the center thereof and, as discussed above, is the surface 24 of one of the extensions 22 in the illustrated embodiment. According to the invention the rear wall of each channel includes a planar surface 64 which is inclined inwardly and rearwardly to permit the rear convex portion of a hammer bar 16 to clear the rear channel wall during insertion or removal of the bar 16. Each lateral end 64a of the surface 64 is, in addition, tapered rearwardly to permit engagement with a surface of one of the wedges 18.

The generally convex front wall of each channel 14 includes a forward surface 66 which extends inwardly and rearwardly from the periphery of the rotor body 12, an inwardly and forwardly extending surface 68 and a forwardly extending surface 70 which, with the inner extremity of surface 68, forms a shoulder 72 for engaging the upper surface 62 of the lip 44. An important feature of the invention is the removal of any sharp edge between the surfaces 66 and 68 which otherwise would interfere with fitting a hammer bar 16 into the channel 14. As seen in FIGURE 5, the intersection of surfaces 66 and 68 has been machined to provide a flat 74 which will not engage any part of a hammer bar 16. The bottom wall of each channel 14 includes a planar surface 76 which joins surface 70 of the front wall to form a pocket for the lip 44.

A coater plate 78 having an upper surface parallel to the axis of the rotor body 12 is secured to each of the lateral extremities of the bottom surface 76, as by welds 80, to serve as a support base for the wedges 18. As best seen in FIGURES 6 and 7 each wedge 18 is an elongated frustum element of generally triangular cross section having a base surface 82 and two wedging surfaces 84 which taper toward each other along the length of the element. As shown, the intersections of the surfaces 82 and 84 are machined flat as at 85. In use, one wedge is inserted, tapered end inwardly, into each end of a channel containing a hammer bar 16 in such a position that the base surface 82 engages the top of a coater plate 78 and the wedging surfaces engage the surface 64a of the channel rear wall and the surface 56a on the rear of the hammer. The wedges in each channel 14 are held in position by means of a rod 86 which passes through a bore 88 in each wedge and which has a suitable fastener at each end. The bore 88 of each wedge 18 is enlarged at its outer end and retains a compressed spring 94 surrounding the rod 86.

Referring again to FIGURE 5 it will be seen that after the wedges 18 have been removed from the lateral ends of the channel 14, the hammer bar 16 can be removed from the channel 14 by rotating it clockwise and at the same time moving it radially outwardly from the rotor body 12. It will be observed that the hammer bar 16 is not tightly engaged by surfaces 24, 66 and 68 when the wedges 18 are not in place, because the channel 14 is of sufficient width to permit a small amount of play between its side walls and the hammer bar 16. To minimize lateral movement of the bar 16, it is rotated slightly clockwise to cause inclined surface 54 to slip upwardly along surface 24 and to cause the surface 58 to begin to pivot against surface 66. By a combination of outward and rotational movements surface 54 continues to slide upwardly along surface 24 while surface 69 moves in an arc away from 68 and the lip 44 moves in an arc away from surface 74. The flat 74 at the intersection of surfaces 66 and 68 prevents the hammer bar 16 from binding against surface 24. Shortly after the lip 44 has cleared the shoulder 72 a position will be reached at which no further rotation of the hammer bar 16 is necessary, and its removal may be rapidly completed with linear movement. Obviously, insertion of a hammer bar may be accomplished by reversing the procedure just described.

Thus, the present invention provides for the simple and rapid insertion and removal of hammer bars in a generally radial direction relative to the rotor body. It will be appreciated, however, that the hammer bars cannot be removed by simple linear movement in a radial direction and that, therefore, the bars will not be thrown out of the rotor body in the event that the wedges are lost during operation. On the contrary, centrifugal force and the forces resulting from impact of the hammer bars on material being crushed tend to lock the lip 44 tightly against the shoulder 72. It will be noted, in addition, that no amount of loosening of the wedges, short of actual removal, will permit the hammer bar to be released from its channel, because removal of a bar is dependent on the pivoting of the rear convex surface thereof through the entire space occupied by the wedges, the invention has been described with reference to a specifically illustrated embodiment, the details thereof are not intended to be limiting except as they appear in the appended claims.

What is claimed is:

1. An impact hammer rotor comprising: a rotor body having at least one longitudinal channel in the periphery thereof extending from one end of said body to the other and parallel to the axis of rotation thereof, said channel having a front wall, a rear wall and a bottom wall; a hammer body detachably fitted in said channel, said hammer body including a body portion having an end above the periphery of said rotor body and a retaining portion residing within the channel; said retaining portion having a generally concave portion engageable with said front wall which defines a complementary, generally convex surface, said complementary surface extending to the periphery of said rotor body; said retaining portion having a generally convex portion on the side thereof of opposite said concave portion, said convex portion merging with said body portion inwardly of the periphery of said rotor body, said hammer body being engageable with said rear wall of said channel at this point; said bottom wall of said channel being spaced inwardly from said lower extremity of said retaining portion, whereby said hammer body is insertable into and removable from said channel by swinging said hammer body in a direction transverse to the axis of rotation of said rotor body; and wedge means detachably secured in each end of said channel and engaging a part of said convex portion of said retaining portion, a part of said channel rear wall and a part of said channel bottom wall whereby said concave portion of said retaining portion is held against said channel front wall.

2. An impact hammer rotor as in claim 1 wherein said said node means includes a tapered member detachably secured in each end of said channel, said member having their longitudinal axes and having their tapered ends facing inwardly of said rotor body.

3. An impact hammer as in claim 2 wherein each of
said members has two planar surfaces which are tapered inwardly toward each other, one of said surfaces engaging a complementary tapered surface at the end of said channel rear wall and the other of said surfaces engaging a complementary tapered surface at the end of said convex portion of said hammer bar retainer portion.

4. A hammer bar for an impact hammer rotor comprising an elongated bar, said bar having: a body portion of generally rectangular transverse cross section; a foot portion integral with said body portion and extending forwardly and downwardly therefrom along a longitudinal face thereof; a generally concave configuration at the inner junction of said foot portion with said body portion, said concave configuration including upper and lower intersecting planar surfaces which are inclined rearwardly; a generally convex configuration at the outer junction of said foot portion with said body portion, said convex configuration including upper and lower intersecting planar surfaces which are inclined forwardly; said foot portion terminating in a lip which extends forwardly therefrom, said lip having a planar surface facing generally upwardly and intersecting the lower of said surfaces which form the concave configuration.

5. An impact hammer rotor comprising: a rotor body having at least one longitudinal channel in the periphery thereof extending from one end of said body to the other and parallel to the axis of rotation thereof, said channel having a front wall, a rear wall and a bottom wall; a hammer bar detachably fitted in said channel, said hammer bar including a body portion having its end above the periphery of said rotor body and a retaining portion residing within the channel; said retaining portion having a generally concave portion engageable with said front wall which defines a complementary, generally convex surface, said complementary surface extending to the periphery of said rotor body; said retaining portion having a generally convex portion on the side thereof opposite said concave portion, said convex portion merging with said body portion inwardly of the periphery of said rotor body, said body portion of said hammer bar engaging said rear wall of said channel outwardly of the point of juncture and said retaining portion being out of engagement with said rear wall of said channel inwardly of the point of juncture; said bottom wall of said channel being spaced inwardly from the lower extremity of said retaining portion, whereby said hammer bar is insertable into and removable from said channel by swinging said hammer bar in a direction transverse to the axis of rotation of said rotor body.

6. An impact hammer rotor as in claim 5 wherein said retaining portion has a forwardly extending lip thereon, said lip having a planar surface facing generally outwardly and intersecting said generally concave portion of said retaining portion and wherein said channel front wall further defines a shoulder engaging said planar surface on said lip.

7. An impact hammer rotor as in claim 6 wherein said planar surface on said lip is normal to the centrifugal force on said hammer bar when said rotor is rotated about its axis of rotation.

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