United States Patent

[11] **3,623,674**

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Original application Nov. 1, 1967, Ser. No. 679,762, now Patent No. 3,531,055. Divided and this application May 7, 1970, Ser. No. 35,423

[54] **HAMMER CRUSHER**
9 Claims, 7 Drawing Figs.

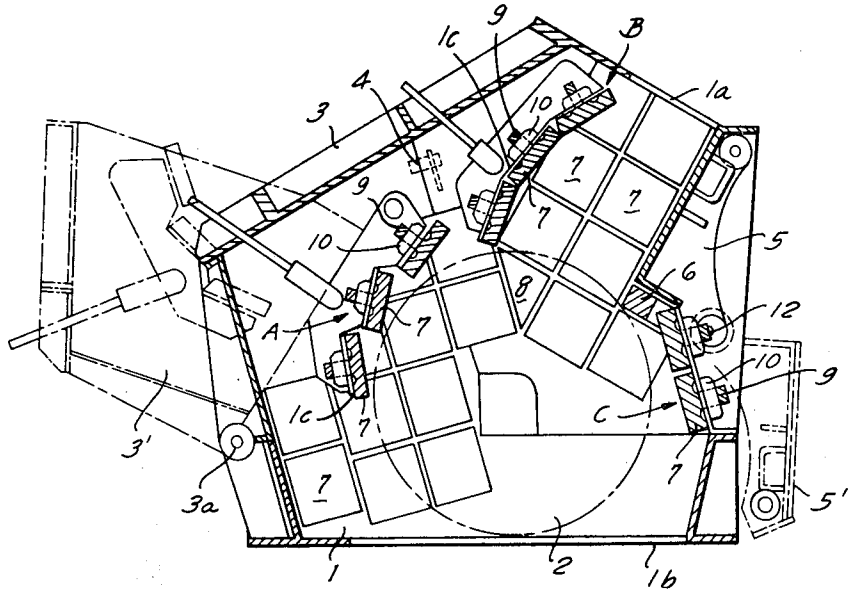
[52] **U.S. Cl.** ..... **241/189 R,** 241/300
[51] **Int. Cl.** **B02c 13/02,** B02c 13/282
[50] **Field of Search** 241/185, 189, 192, 285–288, 300, 294, 299

[56] **References Cited**
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Primary Examiner—Andrew R. Juhasz
Assistant Examiner—Gary L. Smith
Attorney—Michael S. Striker

ABSTRACT: A hammer crusher wherein the internal surfaces of the housing **1** and breaker plates *A*, *B*, *C*, are provided with tessellated armors composed of rectangular and/or triangular metallic sections **7, 8** having slotted projections **9** extending through openings in the housing and breaker plates and receiving elastic wedges **10.** The feed inlet **1***a* is adjacent to a chute **5** which is hinged to the housing, and the hammers **22** of the rotor **2** are held against radial and axial movement. The end plates **31** of the rotor are provided with protective shoes **19** in front of the hammers.



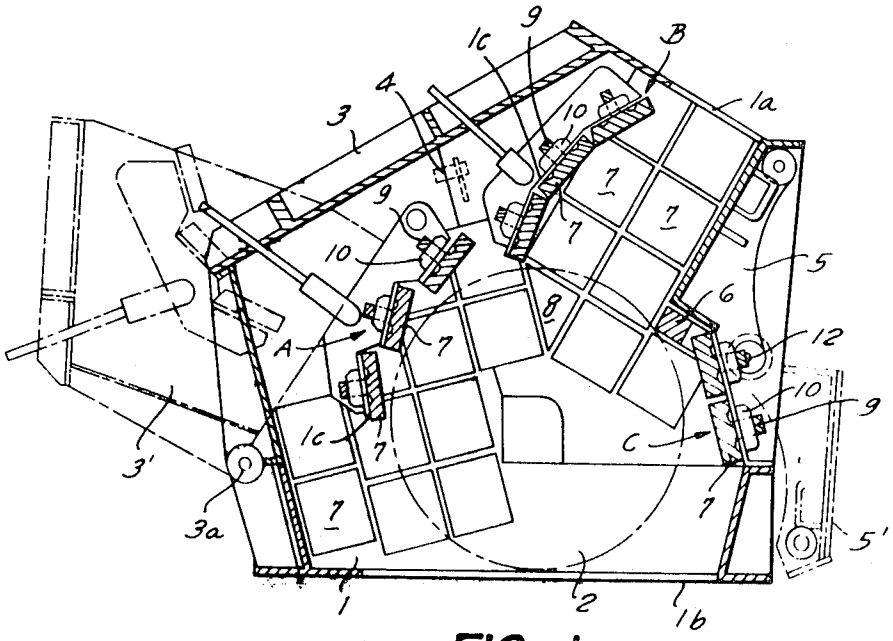


FIG. 1

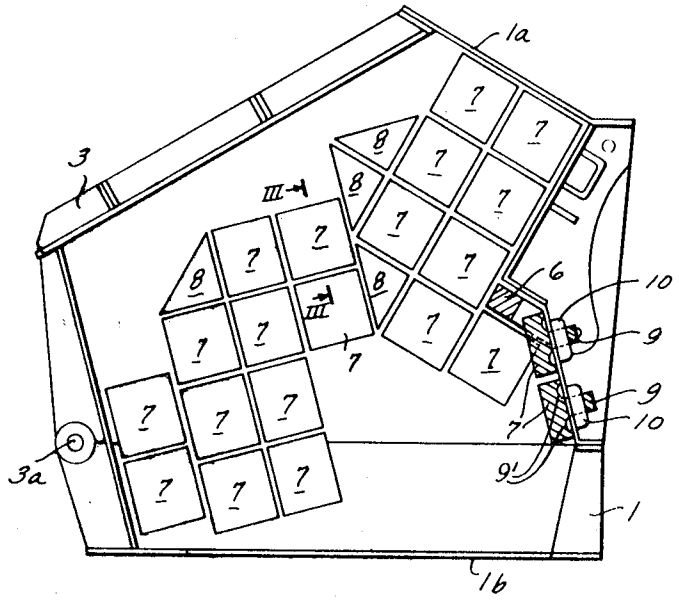


FIG. 2

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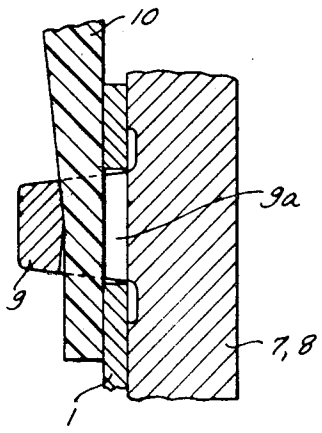


FIG. 3

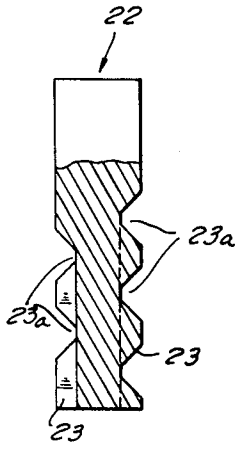


FIG. 7

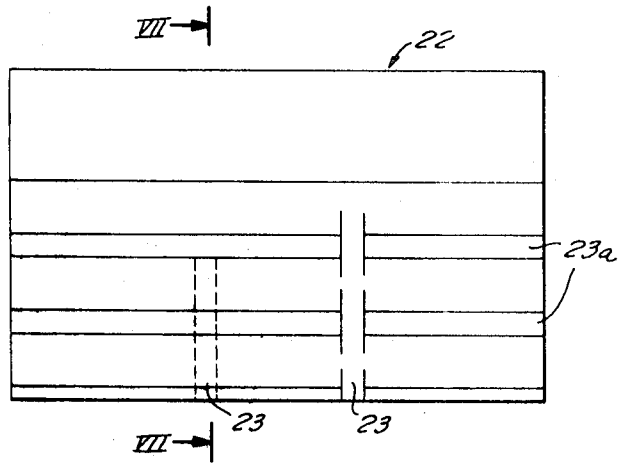


FIG. 6

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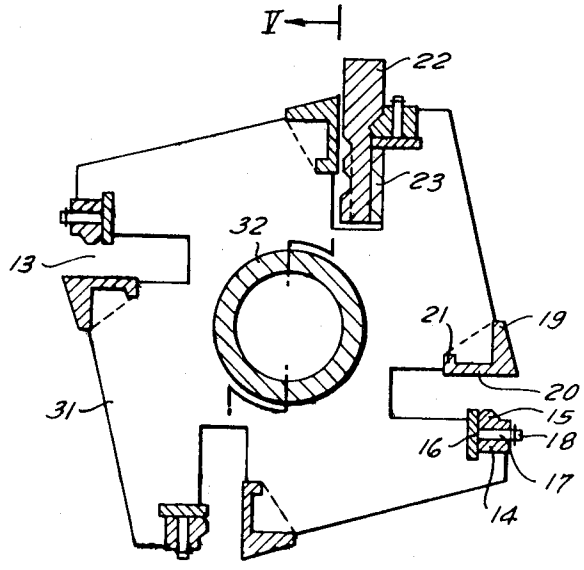


FIG. 4

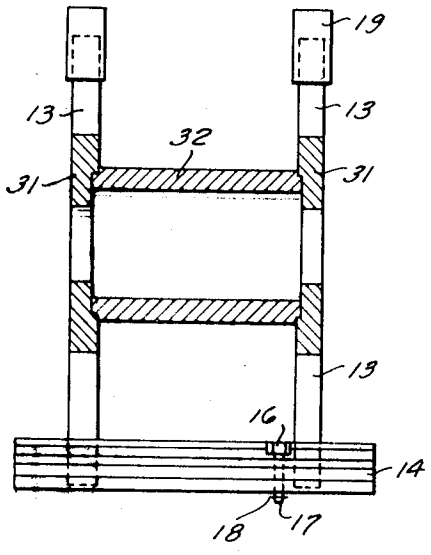


FIG. 5

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HAMMER CRUSHER

CROSS-REFERENCE TO RELATED APPLICATION

The present application is a divisional application of the copending application, Ser. No. 679,762, filed Nov. 1, 1967 now U.S. Pat. No. 3,531,055.

BACKGROUND OF THE INVENTION

The present invention relates to crushing machines in general, and more particularly to improvements in hammer crushers.

Presently known hammer crushers are employed mainly for reduction of relatively soft and medium hard materials. Very hard materials are normally crushed in other types of machines because the wear on the hammers of the rapidly revolving rotor and on the the breaker plates in the housing of a conventional hammer crusher is too high if the hardness of material which is being reduced exceeds a certain value. On the other hand, the comminuting action and the output of hammer crushers are so satisfactory that it is desirable to employ such machines in crushing of all types of materials including hard rock, gravel, basalt or the like. In accordance with presently prevailing practice, the hammers, breaker plates and the housing of a hammer crusher consist of or are armored with layers of wear-resistant material which is supposed to stand long periods of use. Moreover, such armors must be readily accessible for inspection, repair or replacement. In presently known hammer crushers, the the armor consists of chilled cast-metallic stock or mild steel and its relatively large and bulky sections are bolted to the housing. The bolts extend through drilled or cast holes in the armor sections but their heads wear away on contact with the material which is being reduced so that the sections become loose or the workmen cannot apply the tools in order to remove the sections from the housing. Furthermore, the manner of mounting the armor in the housing is such that replacement consumes much time during which the machine remains idle.

SUMMARY OF THE INVENTION

It is an object of my invention to provide a hammer crusher wherein the armor for the housing and/or other parts which come into contact with material to be reduced is assembled and mounted in a novel and improved way to permit inspection, repair and/or replacement with little loss in time.

Another object of the invention is to provide novel and improved means for fastening the sections of armor to the housing and/or other parts of a hammer crusher.

A further object of the invention is to provide a hammer crusher which can be used for reduction of soft, medium hard as well as extremely hard materials, such as basalt, gravel or the like.

Still another object of the invention is to provide novel breaker plates and a novel rotor for use in a hammer crusher.

An additional object of the invention is to provide a novel housing for a hammer crusher and to provide the housing with a novel armor.

A concomitant object of the invention is to provide novel retaining devices for the hammers of a hammer crusher.

An ancillary object of the invention is to provide novel armors for the end plates of the rotor in a hammer crusher.

One feature of my invention resides in the provision of a hammer crusher which comprises a housing member provided with a feed inlet for material to be reduced and a product outlet, at least one rotor mounted in a reducing chamber of the housing member between the inlet and the outlet and having one or more removable hammers which propel the material entering through the inlet, one or more breaker members adjacent to the rotor in the housing member so that the material which is propelled by the hammers rebounds on the breaker members, and a tessellated armor providing a liner along those surfaces of the housing member and breaker members which surround the reducing chamber. The armor is composed of sections which are assembled to form a mosaiclike pattern and have slotted projections extending outwardly through holes or openings provided in the respective surfaces. Wedges or like retaining devices which preferably consist of elastic material are inserted into the slots of projections opposite the respective surfaces to releasably hold the sections in desired positions.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved crusher, itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a vertical sectional view of a hammer crusher with a single rotor which embodies the present invention;

FIG. 2 is a similar sectional view but with the rotor and certain breaker plates removed;

FIG. 3 is an enlarged sectional view as seen in the direction of arrows from the line III—III of FIG. 2;

FIG. 4 is an enlarged transverse vertical sectional view of the rotor in the crusher of FIG. 1;

FIG. 5 is a sectional view as seen in the direction of arrows from the line V—V of FIG. 4;

FIG. 6 is an enlarged plan view of a hammer in the rotor of FIGS. 4 and 5; and

FIG. 7 is a section as seen in the direction of arrows from the line VII—VII of FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates a hammer crusher with a single rotor 2 which comprises an outer housing 1 provided with a feed inlet 1*a* and a product outlet 1*b*. a portion of the inlet 1*a* is bounded by a chute 5 which is connected to the remainder of the housing 1 by a pivot member or hinge 12 so that it can be turned between the solid-line (closed) position and phantom-line (open) position 5'. The rear wall 3 of the housing 1 is similarly mounted on a pivot member or hinge 3*a* and is movable between the solid-line or closed position and a phantom-line or open position 3'. A suitable locking device 4 is provided on the housing 1 to releasably hold the rear wall 3 in closed position. The portions 3 and 5 of the housing 1 are movable between open and closed positions by means of feed screws or by hydraulic or pneumatic cylinders.

The housing 1 accommodates breaker plates A, B and C. Each breaker plate comprises a tessellated armor composed of wear-resistant platelike elements or sections 7 of rectangular or square outline and a holder 1*c* for each section 7. Each section 7 has a rounded projection or extension 9 which extends outwardly, i.e., away from the path in which the material travels through the housing 1. Each projection 9 passes through a suitable opening in the associated holder 1*c*. Elastic retaining members in the form of wedges 10 are introduced through transverse slots 9*a* (see FIG. 3) of the projections 9 behind the respective holders 1*c* to prevent detachment of sections from the holders. Such wedges 10 may consist of suitable wear-resistant synthetic plastic material which is elastically deformable so that it can be forced into the respective slot 9*a* and thereupon prevents uncontrolled or unintentional detachment of the section 7. The projections 9 are preferably integral with the sections 7. It is clear that the wedges 10 may be replaced by S-shaped springs or like elastically deformable retaining members which permit rapid attachment or detachment of sections 7.

The chute 5 extends upwardly from a horizontal bar or beam 6 of preferably square cross-sectional outline. This bar is removably installed in the housing 1 above the breaker plate C and participates in comminution of material which is admitted through the feed inlet 1*a*. When a surface of the bar 6 undergoes a certain wear, the bar is simply turned through 90°,

180° or 270° so as to place another or its surfaces into a position in which such surface comes into contact with material in the reducing chamber of the housing 1. In this way, the bar 6 may be used four times prior to requiring replacement by a fresh bar.

The chute 5 is large enough to permit access to a substantial part of the reducing chamber in the interior of the housing 1 when moved to the phantom-line position 5'. The same applies for the rear wall 3. The breaker plate A is mounted on the rear wall 3 so that it is exposed when the latter assumes the open position 3'. The operators are then free to gain access to the sections 7 of the armor on the breaker plate A for the purpose of inspection, replacement and/or adjustment. The breaker plate B is mounted in the housing 1 opposite the chute 5 so that the sections of its armor are accessible when the chute is moved to the open position 5'. The armor of the breaker plate C is also accessible in response to opening of the chute 5. The projections 9 of sections 7 which form part of the armor on the breaker plate C are accessible at all times because the corresponding holders form part of the housing 1 below the bar 6.

In accordance with another feature of the present invention, the internal surfaces of the stationary part of the housing 1 are also provided with a tessellated armor composed of one, two or more types of wear-resistant sections. In the illustrated embodiment (see particularly FIG. 2), the armor along the internal surfaces of the housing 1 is composed of square sections 7 and triangular sections 8 which are appropriately grouped to form a liner along all such portions of internal surfaces bounding the reducing chamber in the housing 1 which are in the path of flying particles of material that undergoes a comminuting action. The sections 7 of armor in the housing 1 are preferably identical with the sections of the armor on the breaker plates A–C so that the manufacturer need not maintain a supply of several types of wear-resistant sections. In accordance with the simplest embodiment of my invention, all of the sections are of identical shape and size, for example, all such sections may be identical with the square platelike sections 7. However, it is equally within the purview of the present invention to assemble the armors of three or more different types and/or sizes of wear-resistant sections. The sections 7 and 8 are preferably small or relatively small so that they can be readily manipulated by workmen and that localized damage to an armor does not necessitate removal of a relatively large part of the armor. The size and weight of sections 7 and 8 are preferably selected in such a way that these sections can be readily manipulated by repairmen without resorting to cranes or the like. Moreover, the means for detachably fastening the sections 7, 8 to the housing 1 and breaker plates A, B, C are simpler, less expensive and easier to handle if the weight of the sections is relatively small. It will be seen that the sections 7, 8 which form the armor for the stationary parts of the housing 1 are provided with projections 9 which are similar to the aforementioned projections and are affixed to the walls of the housing 1 in the same way as shown in FIG. 3, i.e., by elastically deformable wedges 10 passing through transverse slots 9*a* in the projections 9. The projections 9 of the sections 7, 8 shown in FIG. 2 extend through suitable openings provided therefor in the housing 1 so that the wedges 10 can be inserted or removed from outside, i.e., without necessitating entry into the interior of the housing. The wall 3 and/or chute 5 will be moved to open position when the operators wish to remove certain sections 7 or 8 from the housing 1 so that the sections can be removed from the housing upon removal of the corresponding wedges 10. Each of the sections 7 and 8 on the housing walls and on the breaker plates is provided to opposite sides of the projection 9 thereon with groove-shaped undercuts 9' preferably of semicircular cross section to assure proper abutment of the respective section against the housing or breaker wall surface.

Certain details of the rotor 2 (which is indicated in FIG. 1 by a phantom-line circle) are illustrated in FIGS. 4 to 7. This rotor comprises a hollow shaft 32 which is journaled in the sidewalls of the housing 1 and is driven by a suitable motor, for example, in a manner as shown in Pat. No. 2,958,474 to Meyer which is assigned to the same assignee. The shaft 32 is rigid with two end plates 31 which can be welded or otherwise rigidly secured thereto and carry a set of four platelike hammers 22 (only one shown in FIG. 4). The hammers 22 extend substantially radially of the shaft 32 and portions thereof are received in slots 13 provided therefor in the end plates 31. The means for releasably holding the hammers 22 in the respective slots 13 comprises retaining beams 14 which extend into cutouts machined into the peripheral surfaces of the end plates 31 behind the slots 13 (as considered in the direction of rotation of the rotor 2). In FIG. 4, the rotor is assumed to rotate in a counterclockwise direction so that the hammers 22 are located in front of the respective retaining beams 14. As shown in FIGS. 6 and 7, each hammer 22 is provided with longitudinally extending grooves or flutes 23*a* which are parallel with the axis of the shaft 32 and with transverse grooves or flutes 23 which extent substantially radially of the shaft 32. The flutes 23*a* are provided in both sides of each hammer 22 and the flutes 23*a* in one side are staggered with reference to the flutes 23*a* in the other side. One flute 23*a* of each hammer 22 cooperates with a rib or protuberance 15 of the associated beam 14 to hold the hammer 22 against radially outward movement under the action of centrifugal force when the rotor 2 is driven by the motor to crush the material which is admitted through the feed inlet 1*a*. The beams 14 are welded to the end plates 31 and undergo little wear because they are located behind the respective hammers 22. When the outwardly projecting edge portion of a hammer 22 wears away, the rib 15 of the associated beam 14 is introduced into another flute 23*a* of the hammer so that the latter projects sufficiently from the corresponding slots 13 to provide a satisfactory crushing or comminuting action. If the operator wishes to move the hammer 22 radially outwardly by a relatively small increment, the hammer is withdrawn from the slot 13 in the axial direction of the rotor 2 and is turned through 180° so that the rib 15 is then received in a flute 23*a* at the other side of the reinserted hammer. As stated before, the flutes 23*a* at one side are staggered with reference to the flutes 23*a* at the other side of each hammer 22. If the operator decides that a hammer should be adjusted by a relatively large increment, the hammer is again withdrawn in the axial direction of the rotor 2 and is reinserted without turning so that the rib 15 then extends into another flute 23*a* at the same side of the reinserted hammer.

The purpose of the flutes 23 is to cooperate with bolts 16 which serve to hold the hammers 22 against axial movement with reference to the rotor 2. The bolts 16 are detachably coupled to the respective beams 14 and a portion of each such bolt extends into one of the flutes 23. Each bolt 16 has a stem 17 which passes through a hole in the corresponding beam 14 and is detachably secured to the latter by a cotter pin 18 or the like. Each hammer 22 can be withdrawn in order to permit adjustment with reference to the end plates 31 by first removing the corresponding cotter pin 18, by thereupon removing the corresponding bolt or bolts 16 from the cooperating flute 23, and by then moving the hammer 22 axially of the rotor 2. The housing 1 is provided with one or more doors (not shown) which permit such axial movement of hammers 22. Reinsertion of hammers 22 in adjusted position is carried out in a manner as described above.

The rotor 2 is further provided with locating means for maintaining the hammers 22 in requisite engagement with the beams 14 and bolts 16. In accordance with a feature of my invention, such locating means may simultaneously serve as a means for protecting the edges of end plates 31 against wear. The locating means comprises shields or shoes 19 which are fitted onto the end plates 31 in front of each slot 13 and portions 20 of which extend into the respective slots 13 to hold the hammers 22 against movement in the circumferential direction of the shaft 32 and away from the associated beams 14 and bolts 16. Each portion 20 is provided with a hooked tip

21 which extends into a recess provided therefor in the surface bounding the adjoining slot 13 to thus retain the shoe 19 on the corresponding end plate 31.

An important advantage of the armor shown in FIGS. 1 and 2 is that the sections 7, 8 need not be provided with threads and that the connections between such sections and their supports or holders cannot be damaged by material which is being reduced when the rotor 2 is driven. The projections 9 are coupled to the holders 1c or the walls of the housing 1 by wedges 10 which are located outside of the path of material or outside of the housing 1 so that they are not damaged and allow for rapid detachment of sections 7 or 8. It is clear that each section 7 and/or 8 can be provided with two or even more projections 9. The wedges 10 bear directly against the outer side of the housing 1 or against the rear sides of the holders 1c. The slots 9a preferably extend in parallelism with the adjoining sides of the housing walls or holders. Elastic wedges are preferred when the sections 7, 8 consist of very hard and brittle wear-resistant metallic material which would be likely to crack or to break in response to forcible insertion of a hard wedge. Synthetic rubber of medium hardness has been found to be very satisfactory in the manufacture of wedges.

The pivotably mounted chute 5 enables the operators to gain access to the breaker plate B and C, and the rear wall 3 permits access to the breaker plate A. Such mounting of the parts 3 and 5 renders it possible to replace the sections 7 on the breaker plates with little loss in time and without necessitating even partial dismantling of the rotor. In heretofore known hammer crushers, only the rear wall is removable but the chute and the other portions of the housing around the feed inlet are fixed so that those breaker plates which normally undergo maximum wear cannot be reached save by complete dismantling of the machine.

The beams 14 of the rotor 2 constitute rigid back supports for the hammers 22 and also serve as spacers for the end plates 31 and as a means for holding the hammers 22 against radial and/or axial movement. The hammers 22 need not extend well beyond the respective slots 13 because their comminuting action is more satisfactory if the area of their exposed material-engaging surfaces is relatively small.

The shoes 19 protect those portions of the end plates 31 which are subjected to maximum wear when the rotor 2 is driven by its motor. In the absence of such shoes, the wear on the end plates 31 would rapidly reach such proportions that the hammers 22 would be likely to escape from the slots 13 by moving away from the adjoining ribs 15 and bolts 16. When a hammer 22 is withdrawn from its slot 13, the adjoining shoes 19 can be detached from the end plates 31 without the use of any tools because the tips 21 are loosely inserted into the respective recesses of the end plates. When the hammer is reinserted, the tips 21 cannot be withdrawn from such recesses.

The operators will turn the hammers 22 in order to place sharp edges of such hammers into the path of material which descends along the chute 5 or rebounds from the breaker plates.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. In an impact crusher having a rotor, a combination comprising a housing member surrounding the rotor and having a feed inlet for material to be crushed and a product outlet; at least one breaker member arranged in said housing member so that material entering through said feed inlet in said housing member and propelled by the rotor will rebound on said breaker member; and an armor for at least portions of the inner surface of said housing member, said armor consisting of wear-resistant sections of small size removably affixed to said surface portions and together forming a tessellated linear along said surface portions, the majority of said sections being of identical size and shape.

2. A combination as defined in claim 1, wherein each of said wear-resistant sections of said majority of said sections is of square shape.

3. A combination as defined in claim 1, wherein said breaker member is likewise provided with said armor consisting of sections of wear-resistant material which are identical in size and shape with that of the majority of said sections forming said liner.

4. A combination as defined in claim 3, wherein a plurality of breaker members is provided, each provided on a surface thereof with a plurality of wear-resistant sections, said sections being located at least in some of said breaker members in different planes.

5. A combination as defined in claim 3, wherein each of said members is formed with an opening therethrough extending from a surface facing the rotor to the opposite surface, and wherein each of said sections comprises a projection extending through a respective one of said openings, each of said projections having a slot extending beyond the respective opposite surface and including wedge-shaped retaining means respectively extending through the slots provided in the projections and abutting against said opposite surface for releasably retaining the sections on said members.

6. A combination as defined in claim 4, wherein the projection on each of said sections projects substantially from the center of the respective section.

7. A combination as defined in claim 5, wherein each of said sections is provided at the junction of said projection and the respective section with groove-shaped undercuts.

8. A combination as defined in claim 7, wherein said undercuts have a substantially semicircular cross section and extend into the respective section.

9. A combination as defined in claim 4, wherein said wedge-shaped retaining means are of elastic material.

* * * * *