Sept. 29, 1970 G. ALT 3,531,055

HAMMER CRUSHER

Filed Nov. 1, 1967 3 Sheets-Sheet 1

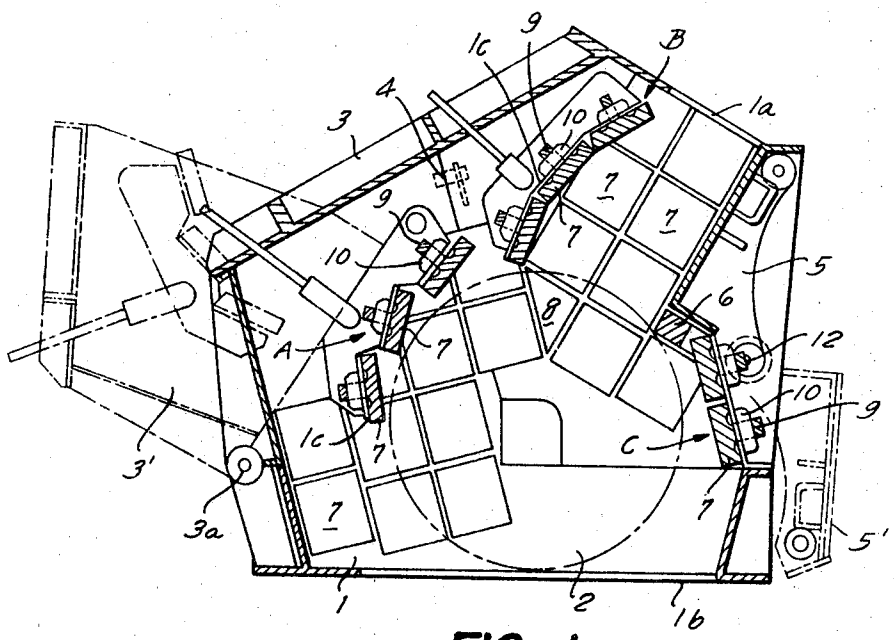


FIG. 1

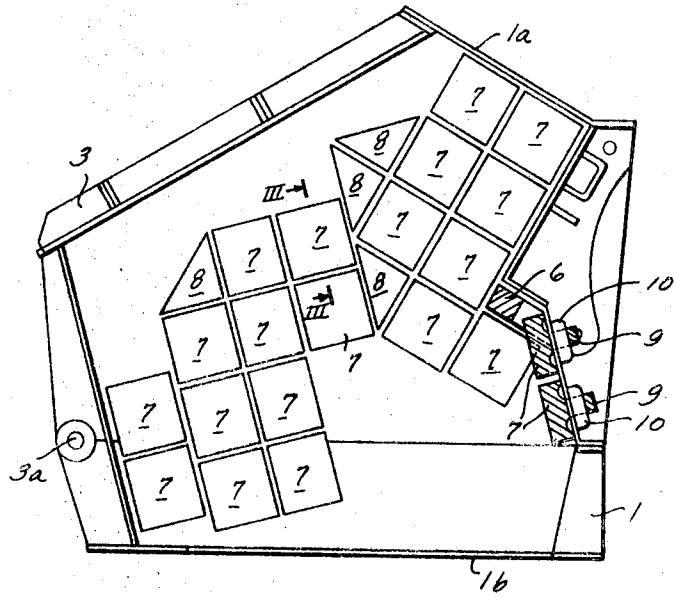


FIG. 2

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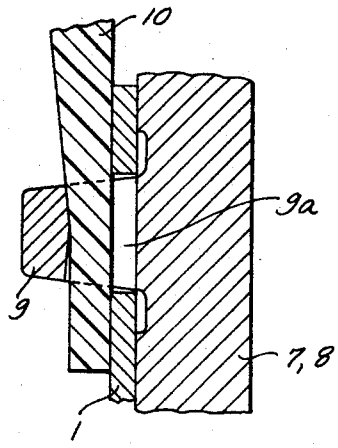


FIG. 3

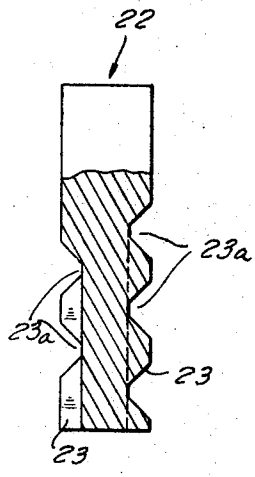


FIG. 7

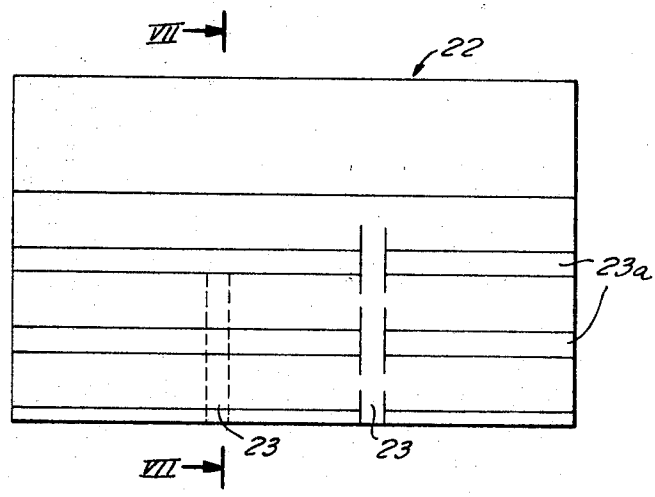


FIG. 6

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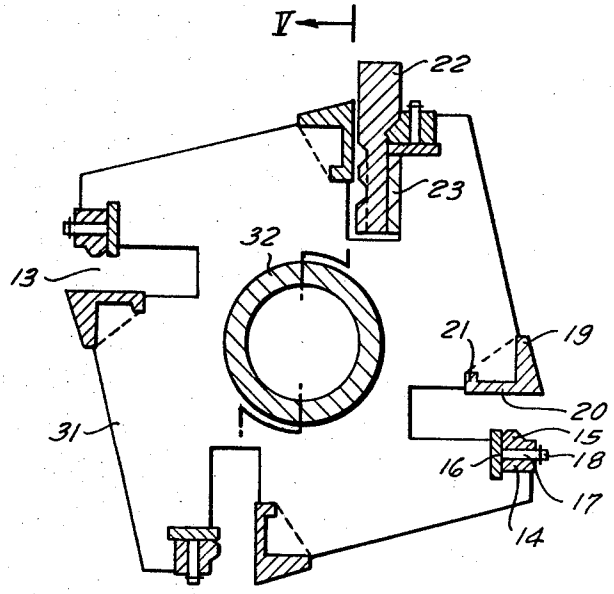


FIG. 4

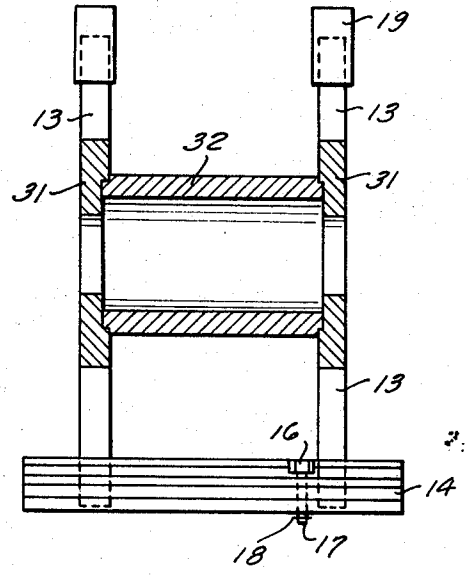


FIG. 5

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3,531,055

# HAMMER CRUSHER

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Int. Cl. B02c *13/09, 13/28, 13/282*
U.S. Cl. 241—192 5 Claims

## ABSTRACT OF THE DISCLOSURE

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.

## 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 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 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 mosaic-like 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 plate-like 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 degrees so as to place another of 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 plate-like 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. tion when the operators wish to remove certain sections **7** or **8** from the housing **1** so that the sections can be The wall **3** and/or chute **5** will be moved to open posi- removed from the housing upon removal of the corresponding wedges **10**.

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 journalled in the side walls 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 plate-like 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 or shoes **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 extend 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 ad-

mitted 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 degrees 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 **1***c* or to 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 **1***c*. The slots **9***a* 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 plates 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 satisafctory 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.

I claim:

**1.** In a hammer crusher having a housing provided with a feed inlet for material to be crushed and a product outlet, a rotor mounted in said housing between said inlet and said outlet and comprising a shaft, two end plates rigid with said shaft and having registering slots, at least one hammer which propels material entering through said inlet, and retaining means carried by said end plates for releasably holding said hammer in said slots.

**2.** A rotor as defined in claim **1**, wherein said retaining means comprises a beam fixed to said end plates between said hammer and having a protuberance extending into one of several elongated flutes provided in said hammer in parallelism with said shaft.

**3.** A rotor as defined in claim **2**, wherein said hammer is further provided with at least one second flute extending substantially radially of said shaft, said retaining means comprising a bolt supported by said beam and extending into said second flute to hold the hammer against axial movement with reference to said shaft.

**4.** A rotor as defined in claim **1**, wherein said retaining means comprises shoes provided on said end plates in front of said hammer and having portions extending into

said slots to hold said hammer against movement in the circumferential direction of said shaft.

5. A rotor as defined in claim 4, wherein said portions of said shoes comprise tips received in recesses provided therefor in the surfaces bounding said slots.


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U.S. Cl. X.R.

241—285