Sept. 1, 1931 I. F. PFEIFFER 1,821,912

PULVERIZING MILL

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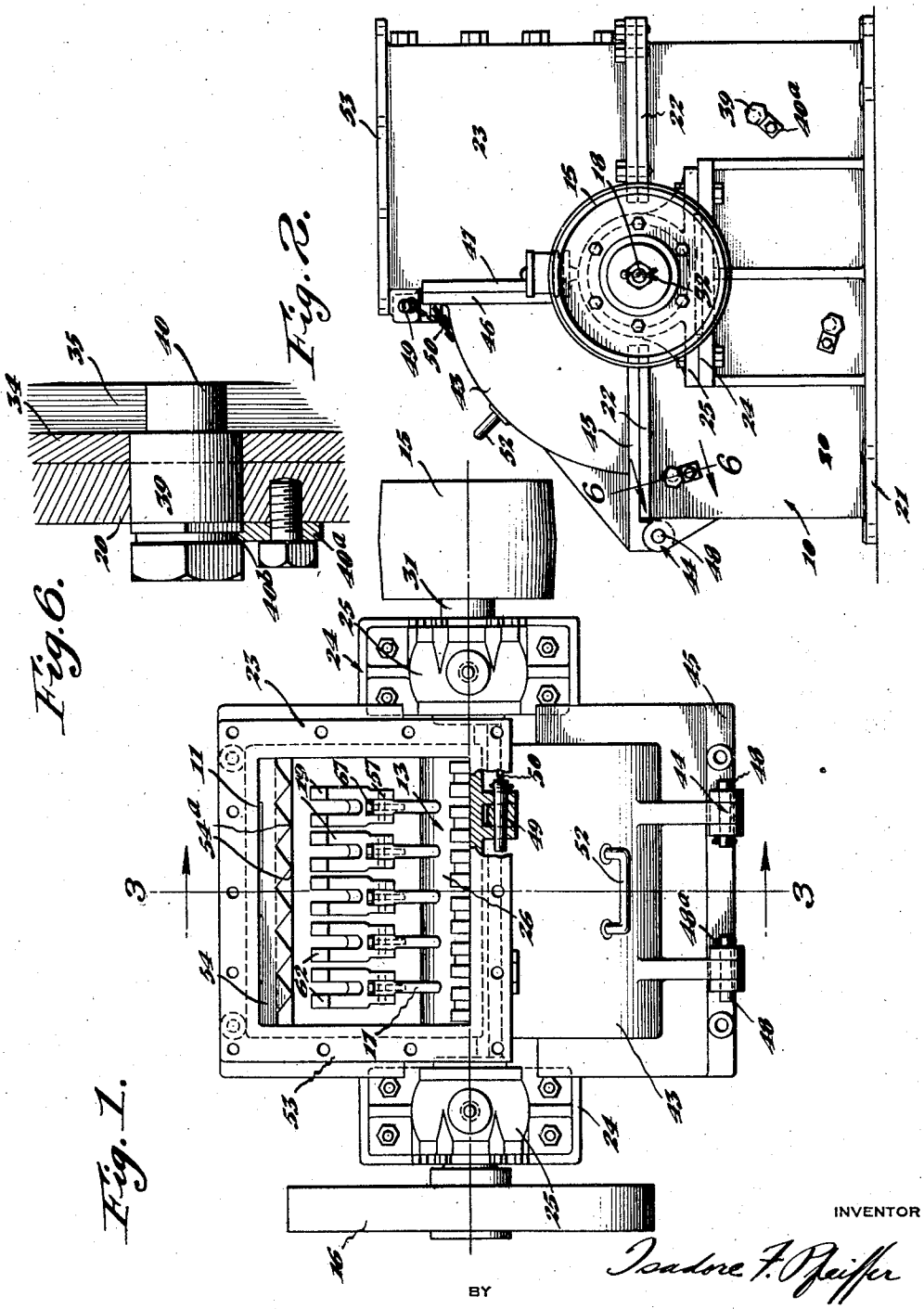


Fig. 2.

Fig. 6.

Fig. 1.

INVENTOR

Isadore F. Pfeiffer

BY

Wood & Wood ATTORNEYS

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Fig. 8.

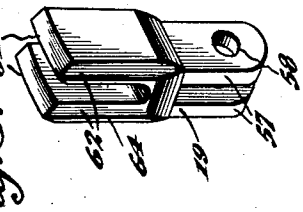


Fig. 10.

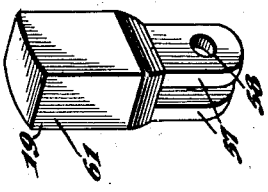


Fig. 9.

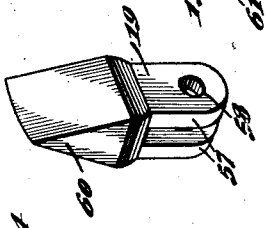


Fig. 7.

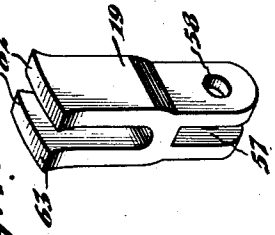


Fig. 3.

INVENTOR

Isadore F. Pfeiffer

BY

Wood & Wood ATTORNEYS

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Fig. 5.

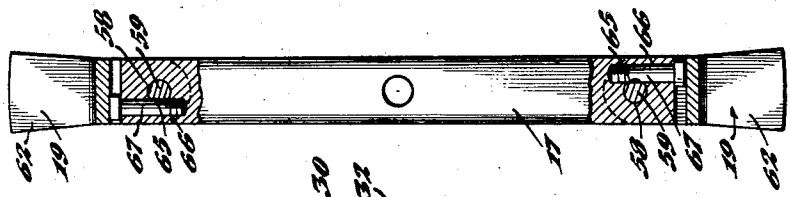
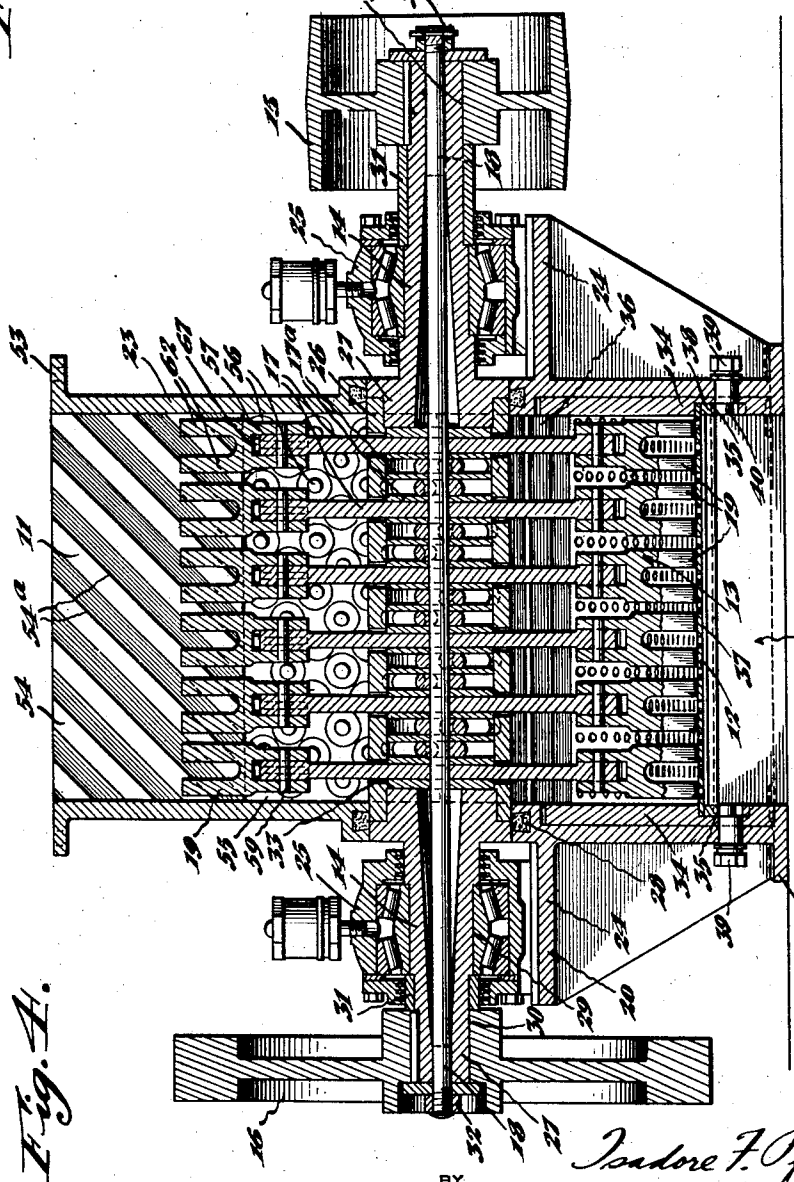


Fig. 4.



INVENTOR

Isadore F. Pfeiffer

BY

Wood & Wood ATTORNEYS

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UNITED STATES PATENT OFFICE

ISADORE F. PFEIFFER, OF AURORA, INDIANA

PULVERIZING MILL

Application filed May 31, 1929. Serial No. 367,170.

This invention relates to mills for pulverizing of crushing material such as limestone, grain, chalk, bones, clay, etc., and is particularly directed to that class of mill employing rotary hammers.

The hammer device in the mill of this invention is designed to provide the necessary give when the hammers strike the material or when there is undue congestion in the pulverizing chamber without detracting from the efficient pulverizing impact and action of the hammer device. The hammers, of various improved constructions providing multiple and efficiently shaped ends, are pivotally connected to the ends of radial holder elements of the rotary device and are free to swing back from an aligned or centrifugally extended relation to the hammer holders when a massing of material prevents centrifugal force from straightening out the hammers. The radial holders and the swinging hammers move relative to the breaking and screening surfaces or lining of the pulverizing chamber in such relation that both the mentioned elements are active in the crushing of the material. The design of the mill in combination with this combined swinging and rigid breaker device arrangement also includes various features to render the mill extremely durable and the parts easily replaceable.

It is an object of this invention to provide a rotary hammer device for a pulverizing mill employing swinging hammers pivotally connected to the ends of radial extending holders, the device being actuated relative to the material to be crushed in such wise that both the hammers and holders are active in the pulverizing of the material.

Another object is to provide a pivotal mounting for the hammers which enables an easy detachment thereof from the holders in the event of breakage, and also which limits the swinging of the hammers to a direction induced by impact on or congestion of the material.

Another object is to provide various types of hammers, single and multiple ended and having various shaped heads all having a standardized connection end for the previously mentioned pivotal attachment to the holders.

Another object is to provide a mounting of the radially extending holders relative to the shaft which permits a rotary give to the holders due to a slight rotary movement thereof relative to the shaft, and which also permits a slight radial springing of the hammers when these actions are induced by a choked condition of the pulverizing chamber or condition of the material.

Another object is to provide a mounting of the shaft of the rotary device in bearings exteriorly of the pulverizing chamber, and placing a dust seal around the shaft at the portions traversing the walls of the pulverizing chamber casing.

Another object relates to the construction and mounting of the breaker plates at the intake of the mill, and also to the construction and mounting of the screening and discharge grating, permitting easy removal of the grating for replacement and interchangeability.

Another object is to provide a door for the mill adjacent the hammer device through which access may be had to the hammers of the mill in the event of breakage, without disturbing the hopper connections to the mill, and also through which door the sectional grating may be removed, and to further provide a means for securely latching the door in sealed closed position.

Other objects and further advantages will be more fully set forth in a description of the accompanying drawings, in which:

Figure 1 is a top plan view of the mill.

Figure 2 is an end elevation thereof.

Figure 3 is a sectional view taken on line 3—3, Figure 1, illustrating the construction and mounting of the rotary device of the mill, certain of the hammer holders and hammers being removed for the sake of clarity.

Figure 4 is a sectional view taken on line 4—4, Figure 1, showing the relation of the rotary element relative to the breaker plates and screening grating of the mill.

Figure 5 is a side elevation of one of the hammer holder bars removed from the mill and having its ends broken away to illus-

trate the pivotal connection of the hammer thereto and the swing limitation means thereof.

Figure 6 is a detail sectional view taken on line 6—6, Figure 2.

Figures 7 to 10 inclusive, are perspective views of various types of hammers for use in this mill.

Referring to the drawings, illustrating this invention, the mill comprises in general the combination of a casing 10 having an intake or hopper opening 11, and a semicircular grinding or screening surface 12, a rotary pulverizing device 13 extending through the pulverizing chamber and having trunnions 14 journalled in bearings exteriorly of the casing, a driving pulley 15 being secured on the outer end of one trunnion and a fly wheel 16 on the other trunnion. A series of tool holders 17 extend radially from the rotary member in longitudinally disposed rows and are secured relative to the rotary element by means of a center rod 18. A hammer 19 is pivotally secured on the end of each holder bar, these hammers being of various formations and single or multiple ended.

Describing the casing 10 in detail, it comprises a lower section 20 rectangular in shape and having flanges 21 for attachment to the floor, and flanges 22 at the top for connection of an upper section 23 and a door 43 thereto, this section 20 being open at the top and bottom. The joinder line of the upper and lower sections is the horizontal center line of the axis of the rotary element.

The lower section provides laterally extending integral bearing platforms 24 supporting split bearings 25, these bearings being traversed by the respective trunnions 14 of the rotary element 13. The rotary element 13 may be described as a hollow shaft. It is fabricated of a cylinder 26 corresponding in length to the width of the casing and a pair of trunnion members 14 having counterturned heads 27, the counterturned portion being engaged within the respective ends of the cylinder and the shanks of the trunnions extending through and beyond the bearings.

The hollow shaft 13 extends loosely through the walls of the casing, that is to say, there is no bearing at this point. Felt rings 28 are dovetailed into the bores in the respective side walls for sealing the openings. In order to provide against longitudinal displacement of the rotary element relative to the bearings, each trunnion is counterturned as at 29 to fit the bore of the respective bearing and counterturned again as at 30 to receive spacer sleeves 31. The fly wheel, in one instance, and the pulley in the other, are secured against the spacer sleeves.

The trunnions are tubular and the center or draw rod 18 extends throughout the length of the rotary element being screw-threaded at each end and provided with nuts 32. The fly wheel and pulley in each instance are secured on the extreme ends of the trunnions and against the spacer sleeves by drawing down the respective nuts against washers engaging the outside faces of the fly wheel and pulley respectively. Keys rotatively secure the fly wheel and pulley to the respective trunnions.

The inner bore of each trunnion is tapered from a straight rod fitting portion at the outer end to a relatively greater diameter at the inner end. This clearing of the rod from engagement toward the inner ends of the trunnions as shown in Figure 3 is for a function relating to the hammer holder and hereinafter described.

The sleeve member of the rotary element has its walls apertured or slotted to receive three longitudinally aligned diametrically disposed sets or rows of hammer holder bars 17. These bars are diametrically disposed through the cylinder so as to provide radially extending portions evenly spaced 60° apart, around the rotary element. Disks 17ª (see Figure 4) are mounted on the rod 18 in the cylinder or hollow shaft 13 between the respective bars 17 for preventing longitudinal shifting of the bar in the slots of the shaft. The slots are slightly greater in width than the thickness of the bars so as to allow the rotary give heretofore mentioned to take place efficiently.

The center rod 18 passes through the center portion of each bar thereby holding the bars against lateral or radial displacement from the rotary element. The rod thus has a twofold function; maintaining the pulley and fly wheel on the rotary element, and maintaining the bars in position. In each instance, the pairs of slots 33 in the adjacent cylinder walls for receiving each bar are formed of sufficient length to permit a slight swinging of each bar on the center rod relative to the cylinder. This construction permitting the holder bar to move relative to the cylinder is illustrated in Figure 4.

A hammer 19 is pivotally mounted on each end of each bar, these hammers swinging close to the semicircular pulverizing and screening surface 12. This last mentioned surface is mounted in the following manner: A rectangular plate 34 is secured against the inner face of each side wall of the casing, each plate having a semicircular cut-away portion concentric with and fitting around the inwardly extending sealing ring boss surrounding the lower half of the rotary element. A semicircular groove 35 is provided in the face of each plate concentric with the axis of rotation of the hammers.

In the upper end of the groove on the intake side of the mill, a curved breaker plate 36 is mounted between and within the respective grooves of the plate, this plate

presenting longitudinally formed sharp edges. The remainder of the semicircular grooves at the respective sides of the casing is filled with the ends of a perforated semicircular plate or grill 37 making up the screening surface 12. This plate 37 has clamping or bearing rings 38 secured to the underside of its side edges. A plurality of fastening devices 39 are provided for securing the plate in position. The plate is slid into the grooves through a door hereinafter described which opens the ends of the grooves, and the plate is clamped against the upper groove edges. The devices 39 are journalled for rotation in the side walls of the casing and the plates, and provide hexagon heads on the outer ends for manipulation and eccentric studs 40 on the inner ends extending into the grooves for engaging the clamping rings. Plates 40^a are pivotally secured to the outer face of the casing, each set in place with a grooved straight edge engaging one side of the hexagon head to prevent rotation of the particular device, and the groove providing a lug 40^b which engages a groove in the hexagon head to prevent axial displacement of the devices from the casing.

The upper section of the casing provides the rectangular hopper opening 11 at the upper portion thereof, this opening approximately corresponding in width to the radius of the rotary pulverizing device. This opening is offset (see Figure 4) and permits the material to be only fed into the intake side of the breaking chamber toward which the hammers revolve.

The upper edges 42 of the side walls of the upper section are concentric with the axis of rotation of the swinging hammers and coincide with the inner line of the screening surface. The door 43 is provided pivotally connected to the lower section by means of a pair of hinge connections 44, this door being semi-circular to fit on the edges 42 and providing a horizontally disposed flange 45 seating on the upper flange 22 of the lower section, and vertically disposed side flanges 46 engaging on corresponding side flanges 47 of the upper section.

The door is clamped in closed position by means of its hinge connections and by means of fastening devices at the swinging end thereof. The hinge pins 48 passing through the lugs of the casing and the lug of the door are tapered. The small ends of the pins carry cotter pins 48^a preventing displacement of the pins but permitting loosening thereof in the tapered bore of the lugs, and the heads of the pins are sufficiently large to prevent the pins from being driven through when driven into clamping position. The upper fastening devices are in the nature of hinge connections but provide removable taper pins 49 connected to the frame by chains 50 attached to the head ends thereof. This arrangement permits the door to be swung down upon removal of the upper pins, and the pins, when set, act to seal the door. The door 43 is also provided with a handle 52 for use in handling the door when the pins have been removed.

The upper margin of the hopper opening is provided with an outwardly extending marginal flange 53 traversable by fastening elements for securing a conduit (not shown) of some sort to the mill. The door is provided in order that the hopper connections need not be disturbed in the even that it becomes necessary to replace any of the hammers, and also in the event that it is necessary to remove the screening plate.

The wall of the upper section toward which the hammers revolve is provided toward its upper end with a lining plate 54 having diagonally disposed sharp breaking edges 54^a. The lower plate 55 adjoining the circular breaker plate and continuing the surface to the plate 36 is provided with rows of conical bosses 56. These plates are secured to the wall of the casing by means of screws. It is thus provided that the entire surface against which the material is disposed within the mill is of an irregular changing breaking surface, the breaking surface terminating in a screening surface for discharging the pulverized material below the mill.

Various types of hammers are used in the mill, the Figures 7 to 10 inclusive, illustrating the hammers. In each instance the hammer is provided with a yoke portion 57 adapted to straddle the plain end of the holder, and having aligned apertures 58 therein for receiving a pivot pin 59 traversing the end of the holder and swingingly securing the hammer to the end of the holder.

The pulverized ends of the hammers vary in form. It may be, as shown in Figures 9 and 10, a solid wedge-shaped head 60 presenting an axe edge, or a solid rectangular head 61, or, as shown in Figures 7 and 8, the head may be slotted to provide a plurality of hammer portions 62. As shown in Figure 7, the respective hammer ends are flared or widened at the ends to provide sharp lateral edges 63. In Figure 8, the forward edges of the hammers and the outer edges thereof are shown as tapered to a point to provide splitting edges 64—64. The hammers may be reversed on the holders when worn on the striking sides.

The pivot pins 59 for securing the hammers to the holders in each instance are provided with a lateral semicircular cross slot 65, this slot being aligned with a bore 66 extending adjacent and at right angles to the pivot pin bore from the outer end of the holder. As illustrated in Figure 5, this last mentioned bore is screw-threaded to receive a screw 67. The screw head being disposed

on the end surface of the holder is in close proximity to the underside of the hammer between the yoke arms thereof for the purpose of preventing swinging of the hammer relative to the holder in anti-clockwise direction. The hammers are free to swing back in the opposite direction. The engagement of the screws with the grooves in the pins prevents lateral displacement and rotation of the pins.

It will readily be seen that by this construction it is provided that both the holder and the hammer are active in the pulverizing and breaking of the material, the apparatus combining swing and rigid hammer principles.

As shown in Figure 4, the hammers swing back upon great resistance to their passage through the material. It depends largely upon the speed and unhindered centrifugal force with which the hammer holder is rotated just how much the hammers straighten out relative to the holders. In the event that the hammer is back, the holder is active in breaking the material. The effect of the device is to swing the hammers into the material. This flexibility and give when great resistance is met, is extremely useful in preventing breakage of the hammers. There is a threefold effort made toward this end. Not only do the hammers swing relative to the holders, but the holders swing relative to the rotary element, and also the holders, due to the spaced mounting of the center rod are free to move slightly in a radial direction. This last result ensues inasmuch as the center rod is flexible and the hammer holders spring the same as necessary.

Having described my invention, I claim:

1. A device of the class described, comprising, a casing constituting a pulverizing chamber, a rotary cylinder disposed across said chamber, means for rotating said cylinder, a series of diametrically disposed holder bars extending through the walls of the cylinder within said chamber, and a center rod secured longitudinally of the cylinder and the respective holder bars for securing said bars relative to said cylinder.

2. A device of the class described, comprising, a casing constituting a pulverizing chamber, a shaft extending through the walls of said chamber, exteriorly disposed bearings for said shaft, means for sealing the openings in the walls of said chamber through which said shaft is disposed, a series of diametrically disposed hammer holder bars extending through said shaft within the chamber, and a center rod secured longitudinally in the shaft and through the respective holder bars for securing said bars relative to said cylinder.

3. A device of the class described, comprising, a casing constituting a pulverizing chamber, a journalled cylinder extending through said chamber, means for rotating said cylinder, a series of hammer devices extending through the walls of the cylinder within the chamber, and means within the cylinder for securing the devices against radial displacement.

4. A device of the class described, comprising, a body constituting a pulverizing chamber, a rotary element extending through the walls of said chamber, means for rotating said rotary element, a series of hammer holder bars extending radially from said rotary element within the chamber, and a center rod secured longitudinally through the rotary element and through the respective holder bars for securing said bars relative to said rotary element.

5. A mill of the class described, comprising, a casing forming a crushing chamber, a journalled tubular shaft extending through said chamber, a series of holder bars disposed radially of and through the walls of said tubular shaft within the casing, a center rod secured longitudinally of and within said shaft, said rod passing through each holder bar, and the openings in the tubular shaft through which said bars extend formed of greater length than the bar width permitting rotative movement of said bars on said center rod relative to said shaft.

6. A mill of the class described, comprising, a casing forming a crushing chamber, a journalled shaft extending through said chamber, a series of holder bars disposed radially of and through slots in said shaft within the casing, the slots in the shaft through which said bars extend formed of greater length than the bar width permitting rotative movement of said bars relative to said shaft, and means for securing the holder bars against radial displacement.

7. In a device of the class described, a casing forming a chamber, a hollow shaft traversing said chamber, a series of holder bars extending radially from said shaft, hammers pivotally secured on the respective outer ends of each holder bar, and a rod secured throughout the shaft and traversing the holder bars for maintaining said bars against radial displacement.

8. A device of the class described, comprising, a casing constituting a chamber for pulverizing material, a cylinder traversing said chamber and having trunnions, bearings for said trunnions, a series of diametrically disposed tool holder bars extending through the walls of said cylinder, a rod extending throughout the length of the cylinder and through the respective bores of said trunnions, means for securing said rod against longitudinal displacement, said rod passing through the centers of the respective bars for securing the same against radial displacement, the bores of said trunnions tapered from a snug rod fit at the outer ends thereof

to relatively large clearance diameters at the ends entering into the cylinder whereby the center rod is permitted to spring under pressure on the holder bars.

9. A device of the class described, comprising, a casing constituting a chamber for pulverizing material, a cylinder traversing said chamber and having trunnions thereon, bearings for said trunnions, a series of tool holder bars extending radially through the walls of said cylinder, a rod extending throughout the length of the cylinder and clear of the walls thereof and through the center bores of said trunnions, means for securing said rod against longitudinal displacement, said rod passing through the respective bars for securing the same against radial displacement relative to the cylinder whereby the rod is free to spring to permit radial movement of the bars.

10. In a device of the class described, a casing forming a pulverizing chamber, a cylinder extending through said casing walls, said cylinder having a trunnion at each end thereof, a bearing for each trunnion mounted exteriorly of said casing, a series of tool holder bars extending radially from said cylinder through apertures in the walls thereof, and a center rod passing through the cylinder and secured in the respective trunnions thereof for maintaining the holder bars in position.

11. In a rotary hammer device, a shaft, radially extending holder bars mounted on said shaft, hammers for attachment to the ends of each holder bar, said hammers having yoke ends, pivot pins traversing the yoke arms of each hammer and the end of the respective holder bar to which it is attached, and screws engaged into the end of each holder bar, each pin having a circular groove in the sides thereof engaged by said screw, the head of said screw engageable with the under surface of the hammer and offset from the pivot center preventing swinging of the hammer in one direction.

12. In a rotary hammer device, a shaft, radially extending holder bars mounted on said shaft, hammers pivotally secured to the ends of each holder bar, and an abutment on the end of each holder bar offset from the pivot center for preventing swinging of the hammer in one direction.

13. A hammer mill comprising, a casing having an intake and screening discharge grating, a rotary pulverizing device disposed therein, and a door pivotally mounted and constituting a circular section of the casing surrounding the rotary pulverizing device, said door having hinge connections at both ends and taper pins at the hinges, whereby access may be had to the hammers through the doorway without disturbing the intake or discharge connection of the mill and the door connections may be sealed by setting the taper pins of the hinges.

14. A rotary hammer device, comprising, a shaft, a series of hammer holders extending from said shaft, hammers pivotally secured on the ends of said holders, and abutments on the ends of said holders preventing pivotal movement of the hammers on the respective holders in one direction beyond aligned relation to the holders.

15. In a hammer mill, in combination with the rotary device and casing therefor, a semicircular door concentrically disposed relative to the rotary device, said door hinged to said casing, taper hinge pins for said hinges, said door having apertured lugs at its upper end, apertured lugs on said casing adjacent the lugs of said door, and removable taper pins traversing the respective bores of the lugs.

In witness whereof, I hereunto subscribe my name.

ISADORE F. PFEIFFER.