

Oct. 5, 1948.

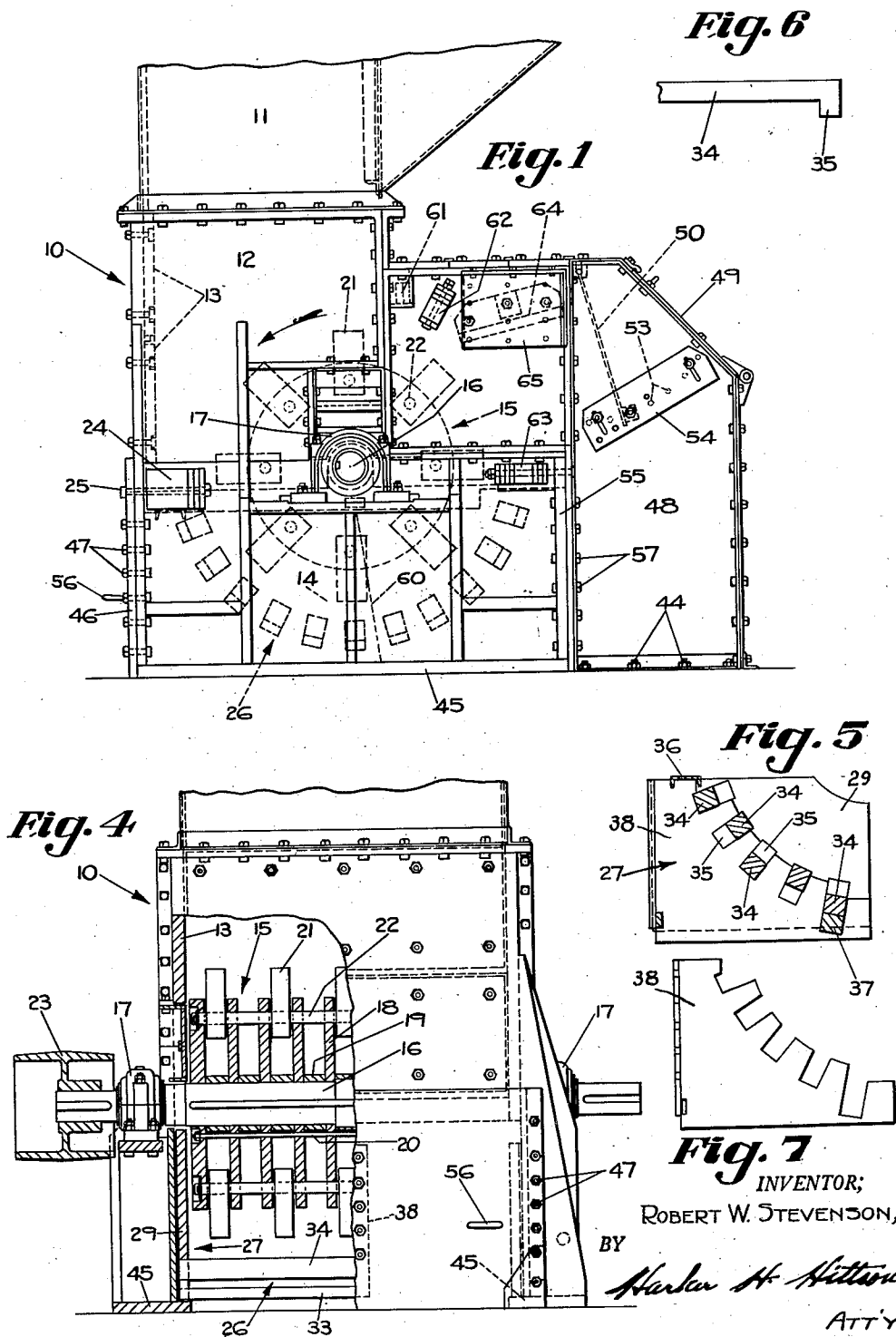
R. W. STEVENSON

2,450,492

REMOVABLE SCREEN STRUCTURE FOR ROTARY BEATER MILLS

Filed May 20, 1944

2 Sheets-Sheet 1



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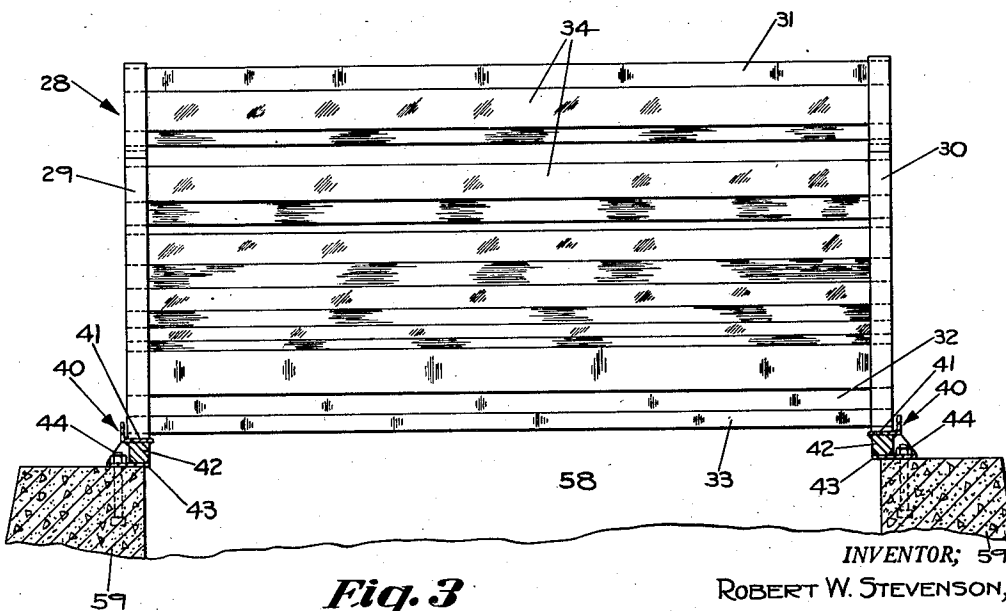
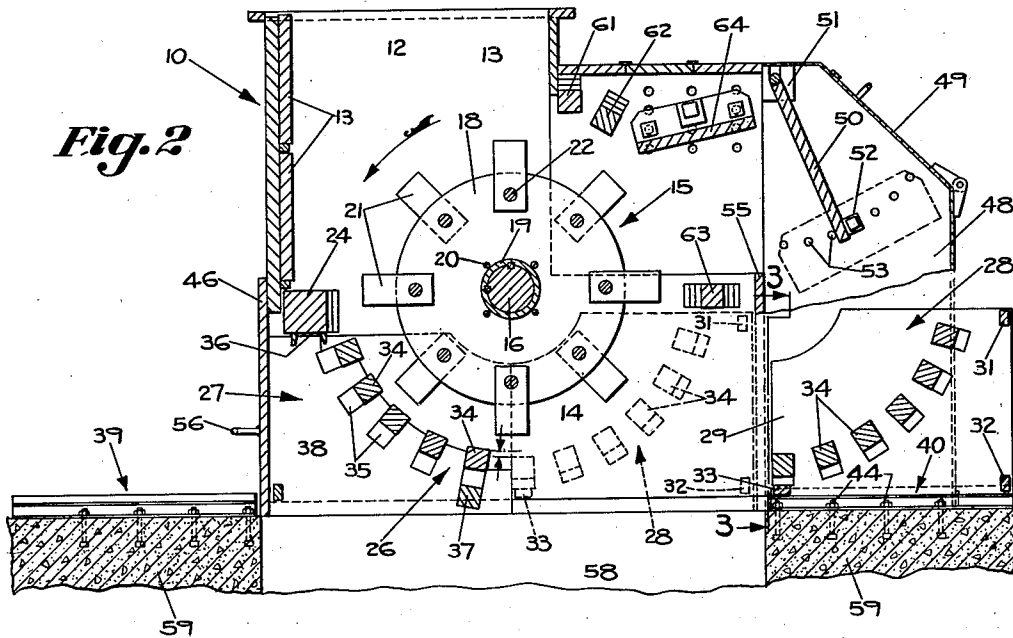
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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REMOVABLE SCREEN STRUCTURE FOR
ROTARY BEATER MILLS

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Application May 20, 1944, Serial No. 536,544

8 Claims. (Cl. 241—89)

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This invention relates to a crusher, and an object of the invention is to provide an improved crusher capable of efficiently reducing substantially any friable material.

A further object of the invention is to provide a crusher in which all or portions of the crusher bar and screen segment are removable from the crusher housing for adjustment, inspection or repair.

Another object of the invention is to provide an improved crusher screen structure wherein cross screen bars are removable from their supporting rack only when the rack is removed from the crusher housing and then by longitudinal movement of the cross screen bars transversely of the cross screen bar supporting members of the rack.

Other objects of the invention will appear hereinafter, the novel features and combinations being set forth in the appended claims.

In the accompanying drawings,

Fig. 1 is a side elevational view of the crusher of my invention;

Fig. 2 is a side sectional elevational view of the crusher in which a modified form of screen and crusher bar arrangement is provided;

Fig. 3 is a transverse elevational view, with parts in section, and showing the mounting of one of the sliding racks and screen bars carried thereby, and taken on the line 3—3 of Fig. 2, looking in the direction of the arrows;

Fig. 4 is a combination sectional and elevational view of the front of the crusher;

Fig. 5 is a sectional view showing one of the sliding racks and screen bars, with the bars adjusted to one of the alternate positions in accordance with one aspect of my invention;

Fig. 6 is a plan view of a detail; and

Fig. 7 is an elevational view of a supporting plate that forms a part of one of the sliding racks.

The crusher of my invention is generally designated as a primary crusher and in one physical embodiment thereof it is exceedingly large and is employed to crush metal turnings or scrap from a machine shop. The crusher, however, is adapted to crush most any friable material, including rock, coal, and the like, particularly where material is quite large as received by the crusher and it is desirable to reduce it only to intermediate size material.

Said crusher includes a housing or casing preferably provided with a feed hopper 11. The housing or casing 10 includes a feed throat 12 at the front side thereof, which is provided with removable breaker plates 13 on both the front

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and side walls of said feed throat 12. The feed throat 12 leads to a central reducing chamber or zone 14 in which there is a rotor 15. The rotor 15 includes a horizontal shaft 16 which extends through the opposite side walls of the housing or casing 10 and is supported in spaced bearings 17 supported on integral standards on the side members of said housing or casing 10.

Mounted on the shaft 16 and keyed thereto is a plurality of spaced discs 18 spaced apart by spacers 19 and tied together with cross bolts 20. Pivotaly mounted near the peripheries of the discs 18 is a plurality of swing hammers 21 which are pivoted on cross-rods 22 extending through aligned holes in the discs 18 and removably held therein by cotter keys. A pulley 23 is keyed to one end of the shaft 16 for driving it.

Extending transversely across the front and bottom of the throat 12 is a heavy primary breaker bar 24 which is adjustably mounted by adjustable spacers in openings or holes in the two side plates of said housing 10. Removable bolts 25 (see Fig. 1) extend through the opposite ends of breaker bar 24 and associated spacers, as well as through the front plate of the housing 10, thereby removably and adjustably holding it in place. The breaker bar 24 may be adjusted toward and from the axis of rotation of the rotor 15 which, of course, is the axis of the shaft 16.

Positioned below the rotor 15 and forming what is in effect the bottom of the reducing chamber 14 is a bar screen or screen cage designated generally by the reference character 26. The bar screen or screen cage 26 in its entirety extends generally along the arc of a circle or a plurality of circles which have their centers along the axis of rotation of the rotor 15, and its circumferential extent is slightly less than 180°.

In view of the size of the machine the matter of adjusting, replacing and repairing individual bars is one of considerable consequence and I have provided a particular construction which makes for ready and convenient inspection, repair and replacement thereof. To this end, the bar screen or cage 26 is made up of two separate units, the two units comprising two sliding racks 27 and 28. The two sliding racks 27 and 28 are slidable into and out of the housing or casing 10 from the front and rear, respectively. In Fig. 2 of the drawings the rack 27 is shown in its operative position and rack 28 is shown in its retracted position and is illustrated in dotted lines in its operative position.

Attention is now directed particularly to Figs. 2 and 3 and to one type of construction of rack

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28. Said rack includes a pair of side plates 29 and 30 which are permanently connected together in spaced apart relation by three transversely extending bars 31, 32 and 33, the opposite ends of which are rigidly attached to said plates 29 and 30, as by welding.

Each of the side plates 29 and 30 is provided with a series of rectangular openings which extend therethrough and have their inner edges formed tangent to a circle, the center of which is along the axis of rotation of the rotor 15 when the rack 28 is in its operative position. Extending between the side plates 29 and 30 and into each of said rectangular openings or sockets is an individual cross-bar 34, said cross-bars being spaced apart to form a screen and being sufficiently rugged to co-operate with the rotor 15 and particularly with the swing hammers 21 thereof to grind or break the friable material being reduced.

To provide for ready adjustment of the radial distance between any selected bar 34 and the axis of rotor 15, the opposite ends of each of the bars 34 are symmetrically formed and include integral feet 35 (see Fig. 6) which together with the bar 34 fill the associated symmetrical opening or socket in the side plate 29 or 30. It is obvious that by the mere expedient of removing a bar 34 and rotating it 180° and reinserting it, its radial distance from the axis of rotation of rotor 15 may be adjusted by the thickness of the feet 35.

The structure of the sliding rack 27 is similar to sliding rack 28 except for certain differences which I shall now point out. First of all, it is, of course, complementary in nature since it is extended into the housing and between the side walls thereof from the reverse side and the two racks cooperate to provide the complete bar screen 26. In addition, instead of a cross-bar 31 I provide a cross channel 36 which is welded at opposite ends to the side plates of the sliding rack 27. Also in place of the cross-bar 33 I provide a heavier and generally square cross-bar 37 welded at opposite ends to the side plates of the sliding rack 27. Cross channel 36, cross-bar 37 and a bar which corresponds with bar 32 of rack 28 permanently connect the side plates of rack 27 in spaced apart relation.

In addition, substantially midway between the side plates of the rack 27 there is an intermediate supporting plate 38 and the inner circular edge thereof terminates a predetermined distance from the tips of the swing hammers 21 when the sliding rack 27 is in its operative position. Plate 38 is rigidly connected with side plates 29 and 30 through cross channel 36, cross-bar 37 and the corner bar which corresponds with corner bar 32 of rack 28. Adjacent its inner circular edge, supporting plate 38 is formed to include a series of rectangular openings or notches which are in alignment with the aligned rectangular openings in side plates 29 and 30 and these openings co-operate with those of the side plates to support and prevent rotation of the cross-bars 34 when the bars are positioned in the rack 27.

The sliding racks 27 and 28 are slidably mounted on individual pairs of rails, the rails for sliding rack 27 being seen at 39, and the rails for sliding rack 28 being seen at 40. The structure of the spaced rails 40 is clearly illustrated in Fig. 3 of the drawings and each includes a top angle 41 with an upwardly extending flange on the outside and with a horizontal flange supporting a side member 29 or 30, as the case may be. Each angle 41 is supported on and welded to

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a square rod 42 which in turn is welded to a bottom plate 43 preferably attached by anchor bolts 44 to a plate or framework which may be the concrete base which supports the complete crusher. The rails 39 are of similar construction.

Said rails 39 and 40 both terminate adjacent the casing 10. Within the casing or housing 10 the sliding racks 27 and 28 are supported on casing bottom plates 45 (see Fig. 4) which extend both inwardly and outwardly of the side plates of said housing 10. It is, of course, obvious that the inner sides of the side plates of the housing 10 form spaced opposed abutments that guide the sliding racks 27 and 28 and their associated cross-bars 34 as a unit within said housing and hold them in their proper positions laterally, as clearly illustrated in Fig. 4 of the drawings. It is to be particularly noted that the cross-bars 34 are held against longitudinal or endwise movement, that is, transverse movement with respect to the end members 29 and 30 of racks 27 and 28 only when the racks 27 and 28 are within the housing 10 and then only by the spaced opposed abutments formed by the walls of the housing which lie adjacent the end members 29 and 30 and the ends of the cross-bars 34.

To hold the sliding rack 27 in position within the casing or housing 10, as illustrated in Fig. 2 of the drawings, and to prevent forward movement thereof while at the same time providing for the forward sliding movement thereof on rails 39, the sliding rack 27 is provided with a front plate 46 which acts as a closure for a front bottom opening in the casing 10 and is removably attached to said casing 10 by removable bolts 47 (see Fig. 1). Obviously by removing the bolts 47 the rack 27 and attached plate 46 may be slid forwardly in drawer-like manner on the rails 39 until rack 27 is entirely outside the housing or casing 10.

To provide for this sliding of the plate 46 the bottoms thereof are notched to clear the rails 39; and laterally spaced anchorages or handles 56 are provided, to which a block and tackle, tractor, truck, or other pulling device may be attached. Upon removal of rack 27 the bars 34 are readily accessible for adjustment, as for example, by turning them over, inspection or removal. To remove the bars 34 after the rack 27 is slid forward outside the casing 10, it is only necessary to slide them axially of themselves or, in other words, transversely of the side plates of said rack 27. After the bars 34 have been adjusted, inspected, or replaced, the complete rack 27 with the bars 34 in place may be slid to the full line position illustrated in Fig. 2, and the closure plate 46 bolted rigidly by bolts 47.

The removability of the sliding rack 28 is generally the same, except for certain differences which shall now be pointed out. The rails 39 are generally left in position. However, the rails 40 are normally removed and the tie bolts 44 normally anchor the bottom of a tramp material bin 48 which is a part of the housing 10. Under certain conditions the tramp material bin 48 may be eliminated and rails 40 left in place, in which case a plate, similar to plate 46, will be attached at the rear of the casing 10 to close it and also hold the sliding rack 28 in place. In the preferred embodiment, however, the tramp material bin 48 is employed. This bin, as above stated, is to the rear of the main portion of the housing 10, and adjacent the top rear portion is provided with a pivoted inspection door 49.

Also across the top of the tramp material bin

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48 is a pivoted deflector plate 50 pivoted at its upper end to spaced hinges 51 on the side plates of said bin 48. The lower end of the deflector plate 50 is provided with attaching lugs 52 on opposite ends thereof, which are adapted to be attached by removable bolts to any one of a plurality of holes 53 in the side plates of the bin 48 positioned on the arc of a circle, the center of which is the pivot point of the plate 50. As illustrated in Fig. 1 of the drawings, cover and reinforcing plates 54 are attached to the side plates of the bin 48 through which the holes 53 extend so as to reinforce the support for the bottom of said deflector plate 50 and to cover holes 53 not occupied by bolts. Plate 54 has a series of holes complementary to the holes 53, but only one of which is in alignment at one time. Sliding of plate 54 brings desired ones into alignment, all other holes 53 being effectively closed by plate 54.

When the sliding rack 28 is in its operating position or the dotted line position of Fig. 2, it is held in place by an upstanding plate or partition 55 which extends laterally between the side plates of the housing 10 and forms the rear bottom portion of said housing 10 and the forward wall of the bottom portion of the tramp material bin 48. This plate 55 is held loosely and removably in place by bolts 57 (see Fig. 1), which also attach the bottom portion of the bin 48 to the main side plates of the housing or casing 10.

To remove the sliding rack 28, the bolts 57 and anchor bolts 44 are disconnected and the complete tramp bin 48 is removed. Plate 55 is then removed. Rails 40 are then attached to the anchor bolts 44, and the sliding rack 28 is slid in drawer-like manner rearwardly over said rails 40, thus providing for inspection, adjustment or renewal of the screen bars 34.

Attention is now directed particularly to certain important characteristics of the sliding racks 27 and 28 and associated cross-bars 34. As illustrated in Fig. 2 of the drawings, the bars 34 are spaced apart circumferentially to provide a screening function so that when material is reduced sufficiently to pass between adjacent bars, it can freely do so and be discharged to the open bottom of the housing 10 and through a discharge opening 58 formed in a supporting base 59 which may be of concrete.

The bars 34 also co-operate with swing hammers 21 to reduce or grind the material, following the first reducing action which takes place by the hammers 21 striking the material in the throat 12 and impelling it against the breaker plates 13. The very heavy primary breaker bar 24 also co-operates with the swing hammers 21 to effect some of the initial breaking, and it is subjected to very severe loads and thus is called upon to perform exceedingly heavy service. That is the reason for its large size as compared with the screen bars 34.

The bars 34 in the rack 27 may be all turned 180°, in which case the feet 35 on the ends thereof will extend inwardly toward the axis of the rotor 15 rather than outwardly, in which case the bars 34 will be spaced apart from the circle generated by the ends of the swing hammers 21, a greater distance as determined by the thickness of the feet 35.

Another alternate arrangement of the bars 34 in the rack 27 is illustrated in Fig. 5 of the drawings, in which case the bars 34 are in staggered relation radially; that is, every other bar 34 is at a different radial distance from the axis of the concentric circles as to which they are

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tangent. As illustrated in Fig. 5 of the drawings, the first, third and fifth bars 34 are tangent to a circle of greater diameter than the second and fourth bars. This provides for an appreciably increased grinding action by the bars 34 during travel of the swing hammers 21 over the bottom forward quadrant of rotation of rotor 15.

Also, as illustrated by arrows in the lower portion of Fig. 2 of the drawings, it will be noted that the radius of the circle as to which the working surfaces of the bars 34 of sliding rack 28 are tangent, has a greater diameter than the concentric circle as to which the working surfaces of the bars 34 of rack 27 are tangent. This arrangement may be employed where the principal grinding action is to take place in the forward lower quadrant of the reducing zone, with the rearward lower quadrant acting more as a screen than as a reducing section. Under some conditions, the sliding rack 28 and all the bars may be completely removed and the material allowed to discharge freely through the bottom of the casing 10 over the rear lower quadrant.

There is another difference between the sliding racks 27 and 28 which is of significance. As previously pointed out, the bar 37 which connects the side members of rack 27 as well as intermediate member 38 thereof, is considerably heavier than the cross-bar 33 of rack 28. By virtue of this heavy construction of bar 37, it may be employed to aid in supporting the bar 34 directly across from it, and this is frequently desirable, particularly where said bar 34 across from it is the last reducing bar in the lower forward quadrant of the reducing chamber 14, since such last bar always takes a heavier load than the other bars. This reinforcement may be effected by placing intermediate feet on the bar 34 or by providing a reinforcing bar which fills the space between the bar 34 and the bar 37. Of course, if the bar 34 is rotated 180° from the position illustrated, the bottom thereof then will lie flat on the top of the bar 37 and be reinforced.

It may also be mentioned that the plane of severance between the sliding racks 27 and 28, as illustrated in Fig. 2 of the drawings, is along a vertical plane passing through the axis of rotation of rotor 15, and the two inner ends of the racks 27 and 28 abut each other, thus co-operating to maintain themselves in proper position.

A slightly different arrangement of the bars 34 and slide racks is illustrated in Fig. 1 of the drawings. Here all of the screen bars 34 are tangent to the same circle, the center of which is along the axis of shaft 16 so that substantially the entire area of the bar screen 26 acts as both a reducing member and screen member. Also in this arrangement, the split between the two sliding racks 27 and 28 is not vertical but is along a radial line 60.

In addition to the breaker bars and rack bars previously mentioned, in the upper rear quadrant of the reducing chamber 14 and what constitutes an entrance to the tramp material bin 48, I preferably provide a pair of adjustable breaker bars 61 and 62 adjustably mounted in the side plates of the casing or housing 10. In addition, there is also a transverse breaker bar 63 provided at the rear portion of the casing 10 and substantially opposite the primary breaker bar 24. Breaker bar 63 is mounted in the side plates of the casing 10 and is provided with adjusting shims, as clearly illustrated in Figs. 1 and 2 of the drawings.

Also in the upper rear portion of the casing

10 is an adjustable tramp material deflector plate 64 provided with upwardly extending end flanges which are bolted by removable bolts extending through selected ones of a plurality of holes in the side plates of said casing 10 covered by outside cover plates 65 (see Fig. 1). The deflector plate 64 extends in a horizontal or nearly horizontal position but may be inclined upwardly and rearwardly.

In the operation of the machine, friable material, such as stone, coal, metal turnings, or any other of a wide variety of materials which can be broken down by a crusher, will be fed through the throat 12 from the hopper 11. The rotor 15 will be rotated in the direction indicated by the arrow, and the swing hammers 21 will strike the material as it comes down through the throat and in effect support the material in a floating condition, breaking or chopping the bottom thereof and disintegrating it at least in part and throwing it against the breaker plates 13. This, of course, will produce additional breaking down of the material. The swing hammers 21 will also co-operate with the primary breaker bar 24 to break down material further and this breaking action will continue together with what is more in the nature of a grinding action, in connection with the breaker or screen bars 34 of the sliding rack 27 which are within the lower forward quadrant of the reducing zone or chamber 14. If the bars 34 are in the staggered relation as illustrated in Fig. 5, there will be a greater breaking and less grinding action in this zone. Simultaneously with this breaking action, the spacing of the bars 34 provides a screening action and the material which is sufficiently reduced will pass through the spaces between the bars 34 and downwardly out the open bottom of the casing 10 and through the discharge opening 58. As the material reaches the lower rear quadrant of the reducing chamber 14, there will be an expansion of said chamber by virtue of the greater radial distances of the bars 34 and consequently there will be less breaking action and more screening action through this zone.

Tramp material which passes through the reducing zone will be thrown by the rotor 15 against the first deflector plate 64 which will deflect it toward the second deflector plate 50 which in turn will deflect it to the bottom of the tramp material bin 48. The deflector plates 64 and 50 may be adjusted in their angular relations, depending upon the material being treated, so as to provide for a proper guiding of said tramp material into the material bin 48. Any particles of reduced material which reach the upper rear zone of the reducing chamber 14 will be reduced by the cross-bars 61 and 62 and, of course, the cross-bar 63 will also aid in reducing material which strikes it.

As previously suggested, one of the important contributions of the invention is the fact that the bar assemblies may be removed as units from the casing 10 by sliding the individual sliding racks 27 and/or 28 completely outside the casing 10, where the bars may be inspected and repaired without any interference whatever from the rotor 15, and while they are freely accessible on practically all sides. As above mentioned, in one embodiment of my invention, the crusher is of considerable size and consequently even the bars 34 are of such weight that it is very difficult for a man to lift them. Purely by way of example, one crusher is almost eight feet from the foundation to the top of the throat 12. It is to be

understood, however, that the features of my invention may be employed with crushers of any size.

Obviously those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of the invention as defined by the claims hereto appended, and I therefore wish not to be restricted to the precise construction herein disclosed.

Having thus described and shown an embodiment of my invention, what I desire to secure by Letters Patent of the United States is:

1. In a crusher, a housing, a rotor in said housing, an adjustable screen in said housing adapted to co-operate with said rotor for crushing and grinding material fed into the crusher including a plurality of cross screen bars having offset symmetrical ends, a rack supporting the said cross screen bars slidable into and out of the housing in a drawer-like manner including a pair of spaced interconnected end members having pairs of aligned symmetrical openings extending therethrough, each pair of aligned symmetrical openings receiving the offset ends of one of said cross screen bars whereby the rack and cross screen bars are slidably removable from said housing as a unit and the cross screen bars individually removable and rotatably positionable within the aligned symmetrical openings in said rack to provide for the adjustment of the cross screen bars relative to the rotor, said cross screen bars being removable from said rack by movement transverse of said rack end members.

2. In a crusher, a housing having side walls forming spaced opposed abutments, a rotor in said housing, an adjustable screen in said housing adapted to co-operate with said rotor for crushing and grinding material fed into the crusher including a plurality of cross screen bars extending within said housing between said opposed abutments and having offset symmetrical ends, the said abutments being adapted to arrest endwise movement of said cross screen bars, and a rack supporting said cross screen bars slidable into and out of said housing in drawer-like manner from between said abutments, said rack including a pair of spaced interconnected end members having pairs of aligned symmetrical openings extending therethrough, each pair of aligned symmetrical openings receiving the offset symmetrical ends of one of said cross screen bars whereby the rack and cross screen bars are slidably removable from said housing as a unit and the cross screen bars are individually removable and rotatably positionable within the aligned symmetrical openings in said rack to provide for the adjustment of the cross screen bars relative to the rotor, said cross screen bars being removable from said rack by movement transverse of said rack end members.

3. In a crusher, a housing, a rotor in said housing, a screen in said housing adapted to co-operate with said rotor for crushing and grinding material fed into the crusher including a plurality of cross screen bars having symmetrical ends, a rack supporting said cross screen bars slidable into and out of the housing in a drawer-like manner including a pair of spaced interconnected end members having pairs of aligned symmetrical openings extending therethrough, each pair of aligned symmetrical openings receiving the ends of one of said cross screen bars whereby the rack and cross screen bars are slidably removable from said housing as a unit and the cross bars individually removable and rotatably positionable

within the aligned openings in said rack only by movement transverse of said rack end members.

4. In a crusher, a housing having side walls forming spaced opposed abutments, a rotor in said housing, a screen in said housing adapted to co-operate with said rotor for crushing and grinding material fed into the crusher including a plurality of cross screen bars extending within said housing between said spaced opposed abutments, said abutments being adapted to arrest endwise movement of said cross screen bars, and a rack supporting said cross screen bars slidable into and out of said housing from between said abutments, said rack including a pair of spaced interconnected end members having pairs of aligned openings extending therethrough, each pair of aligned openings receiving the ends of one of said cross screen bars whereby the rack and cross screen bars are slidably removable from said housing as a unit and the cross screen bars are individually removable from said aligned openings in said rack by movement transverse of said rack end members.

5. In an adjustable bar screen assembly adapted to co-operate with the rotor of a crusher, a rack including a pair of spaced end plates, means interconnecting said end plates, said end plates having a plurality of rectangular openings formed therein substantially upon the arc of a circle, the openings in each end plate aligning with corresponding openings in the other end plate, and a plurality of screen bars each having rectangular offset end portions adapted to be received by said rectangular openings in said end plates, the screen bars being removable from said rack only by longitudinal movement thereof transverse of said end plates and being rotatably replaceable therein for adjustment of the screen.

6. A rack adapted to carry cross screen bars of a crusher screen having rectangular bearing sections including a pair of spaced end plates, means permanently interconnecting said end plates, said end plates each having a plurality of rectangular openings formed therein and lying substantially upon the arc of a circle, the openings in each end plate aligning with corresponding openings in the other end plate for receiving rectangular end bearing sections of cross screen bars, and a member spaced between said end plates and interconnected therewith having rectangular openings therein aligned with said aligned openings in the end plates for receiving other rectangular bearing portions of said cross screen bars whereby the cross screen bars carried by said rack are removable therefrom by endwise movement transverse of said end plates.

7. A rack adapted to carry cross screen bars of a crusher screen having bearing sections including a pair of spaced end plates, means permanently interconnecting said end plates, said end plates each having a plurality of openings formed therein and lying substantially upon the arc of a circle, the openings in each end plate aligning

with corresponding openings in the other end plate for receiving end bearing sections of cross screen bars, and a member spaced between said end plates and interconnected therewith having openings therein aligned with said aligned openings in the end plates for receiving other bearing portions of said cross screen bars whereby the cross screen bars carried by said rack are removable therefrom by endwise movement transverse of said end plates.

8. A rack adapted to carry cross screen bars of a crusher screen having rectangular end bearing portions including a pair of spaced end plates, means permanently interconnecting said end plates, said end plates each having a plurality of rectangular openings formed therein substantially upon the arc of a circle, the openings in each end plate aligning with corresponding openings in the other end plate for receiving the rectangular end bearing portions of cross section bars whereby the cross screen bars carried by said rack are removable therefrom by endwise movement transverse of said end plates.

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