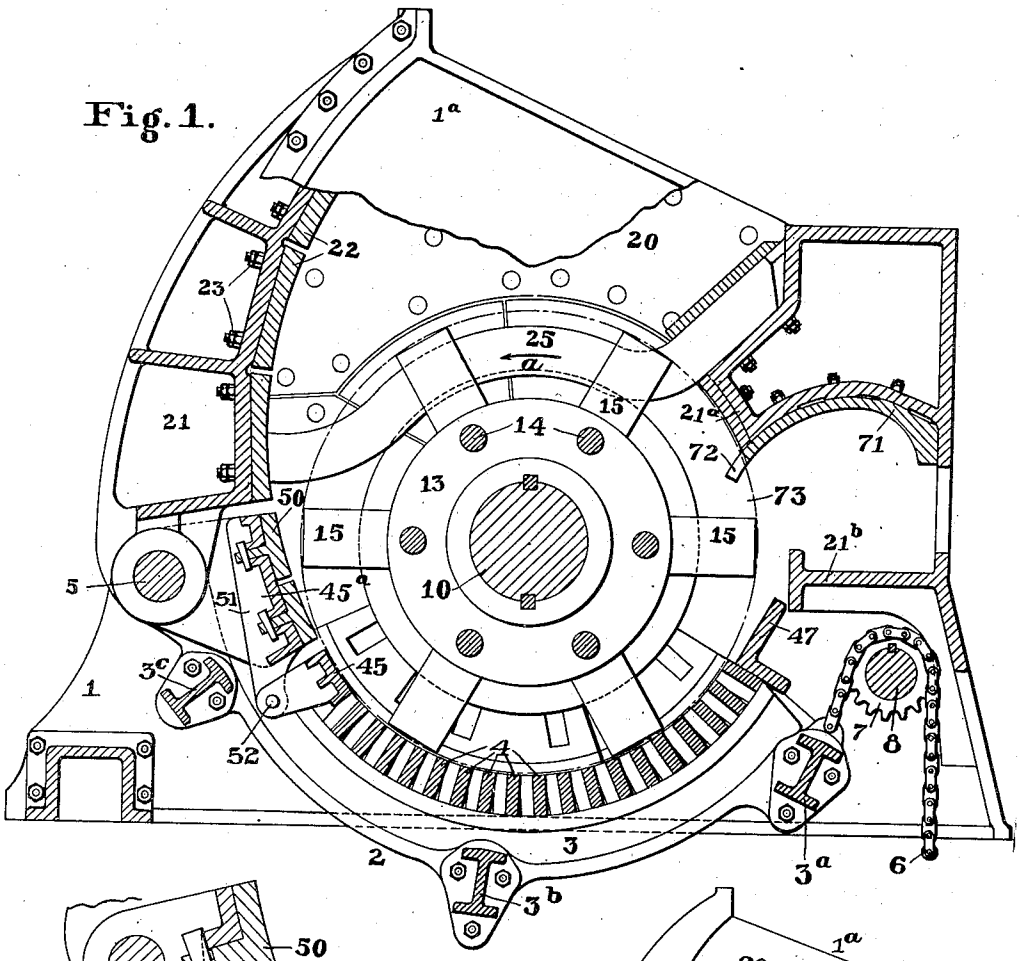
Sept. 13, 1932. G. W. BORTON 1,877,121

HAMMER CRUSHER

Original Filed Aug. 25, 1928 3 Sheets-Sheet 1

Fig. 1.



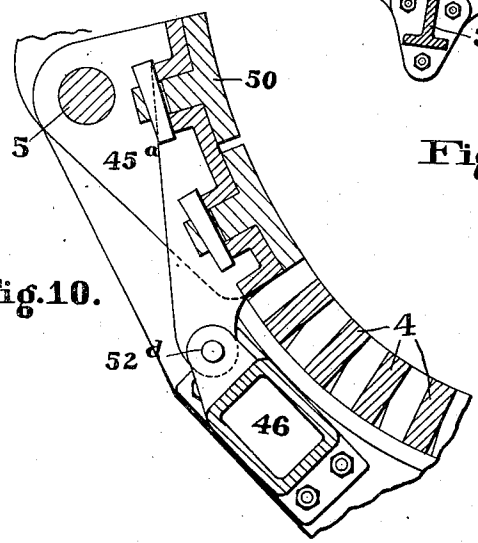
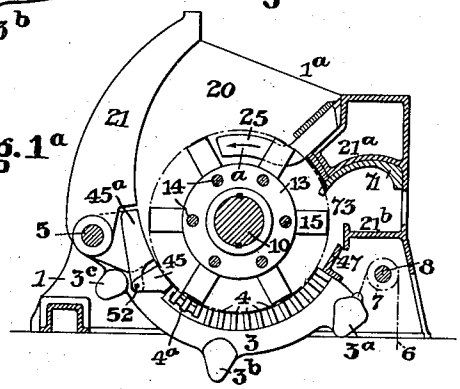


Fig.10.

Fig.1a



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HAMMER CRUSHER

Original Filed Aug. 25, 1928 3 Sheets-Sheet 2

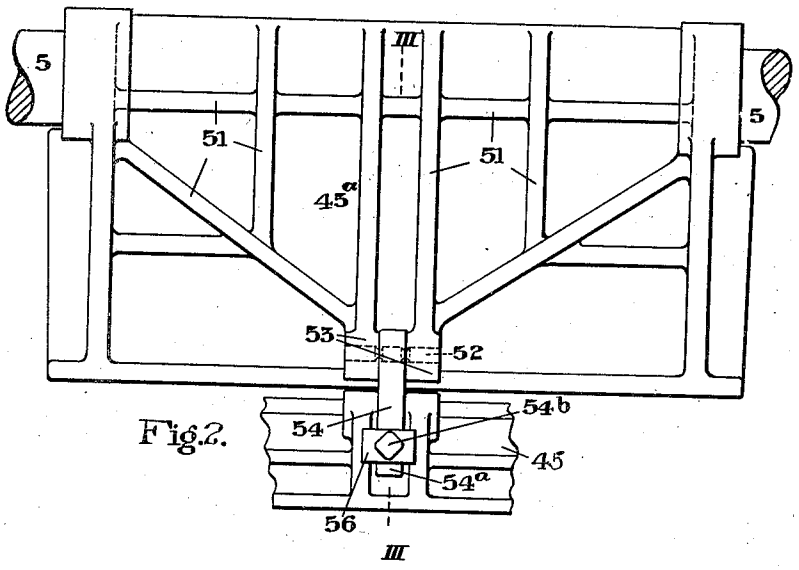

Fig.2.

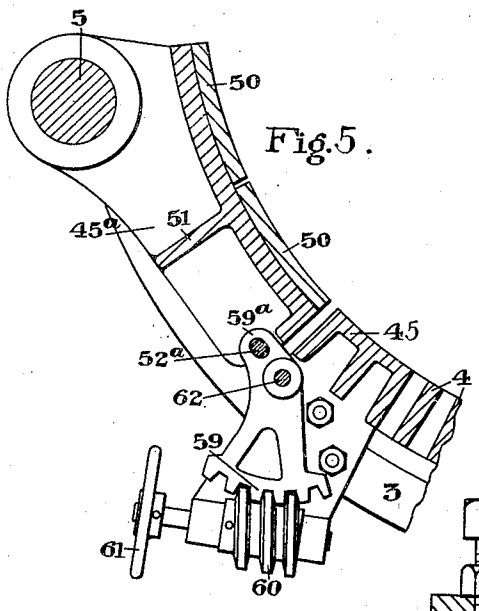

Fig.5.

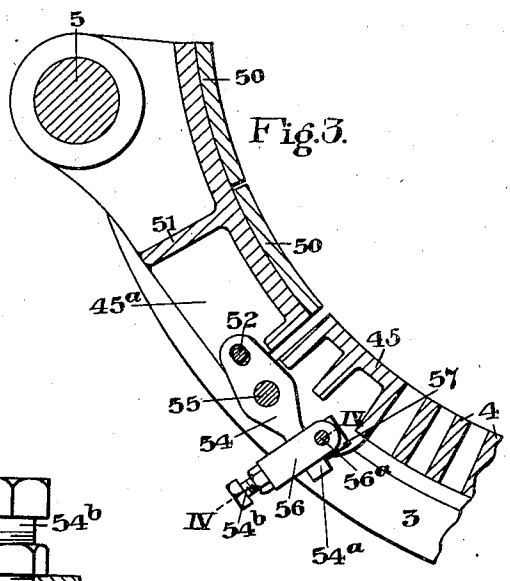

Fig.3.

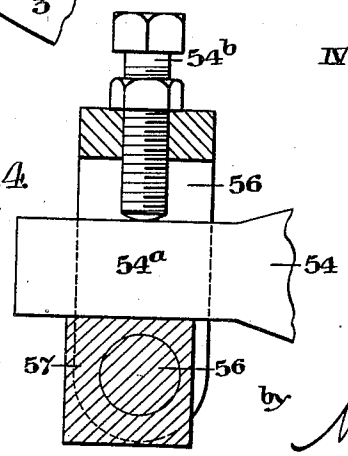

Fig.4

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HAMMER CRUSHER

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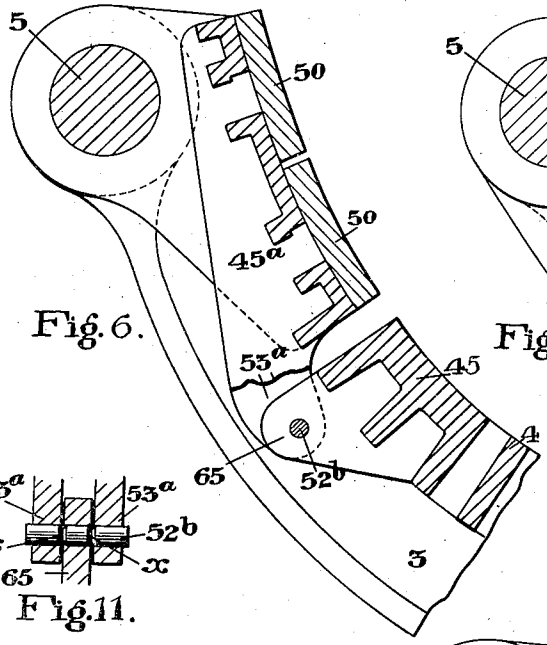

Fig. 6.

Fig. 11.

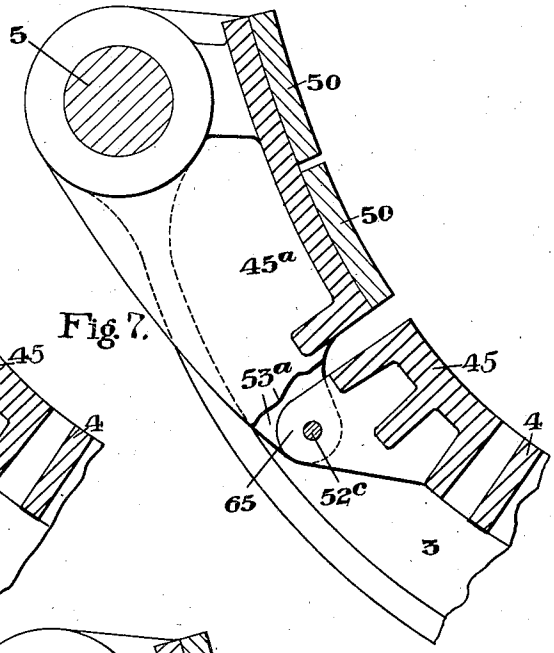

Fig. 7.

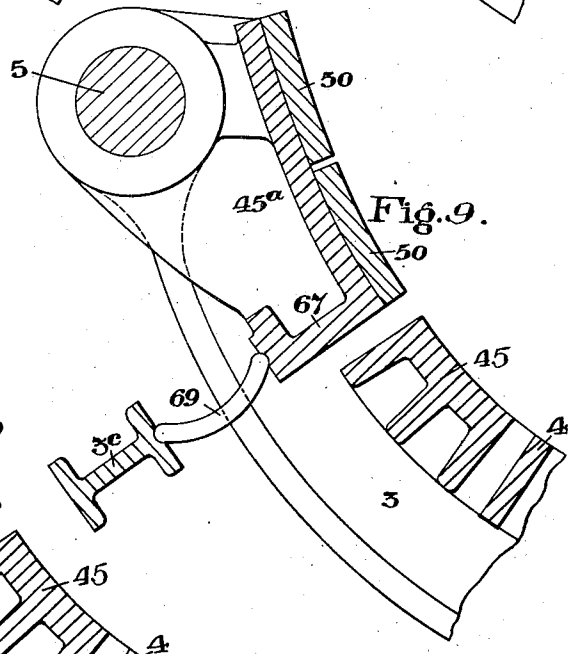

Fig. 9.

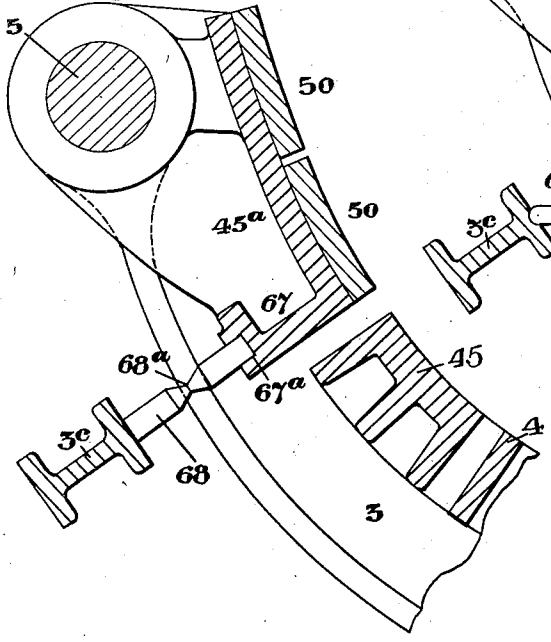

Fig. 8.

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UNITED STATES PATENT OFFICE

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HAMMER CRUSHER

Original application filed August 25, 1928, Serial No. 302,080. Divided and this application filed January 20, 1930. Serial No. 422,239.

My invention relates to hammer mill crushing structures, that is to say, structures which involve a supporting base; a suitable housing or frame mounted thereon and enclosing a chamber receiving the material to be crushed and including a breaker plate (or plates); a cage or screen made up of suitable grate bars, and a rotor structure carrying a series of hammers. The machine is of massive and rigid construction and is designed to receive what is known as "steam-shovel feed" or the contents of a quarry car, which may be delivered directly into the hopper leading to the crushing zone.

My present improvements, comprising features of the cage or screen forming the lower part of the crushing chamber, have been applied to a structure of the type set forth in my pending application filed Aug. 25, 1928, Serial No. 302,080, wherein I have described a machine highly efficient for the crushing of material by what may be termed uprunning hammers, that is to say, hammers which pass upward between grid bars located in the feed hopper and which serve as temporary supporting means for the material operated upon; which hammers, in addition to the incremental breaking or crushing action which they impart, tend to lift the material to be crushed from said grid bars or other temporary support; thereby assisting in the dislodgment of the larger masses of material temporarily retarded by the grid bars and insuring proper reduction of the same for subsequent delivery, substantially by gravity, into the path of the hammers for further reduction in cooperation with the bars or other breaking elements of the cage or screen. An important feature of the crusher structure resides in the feed hopper into which the material to be crushed is dumped; one wall of the same being in the form of a heavy, reinforced plate constituting a breaking surface; such plate being preferably curved and partially overhanging the hopper and pivotally connected to the crusher frame.

One object of my present invention is to provide the cage or screen forming the lower part of the crushing chamber and carrying the bars with which the hammers cooperate in effecting final crushing, with a supplemental breaker plate (or plates). The supplemental breaker plate may be disposed at the upper end of the cage or screen and may be hung from the rod or shaft supporting one end of such cage or screen, which also supports the curved breaker wall of the hopper.

A further object of my invention is to provide adjusting means for the supplemental breaker plate (or plates).

A further object of my invention is to support the supplemental breaker plate in active position by breakable means which may rupture and permit temporary displacement without damage to the rest of the machine, if uncrushable objects brought into contact with such plate effect a breaking stress during the crushing action.

And a still further object of my invention is to associate such breakable element with the adjusting means for the supplemental breaker plate (or plates).

The cage or screen may be provided with several sets or series of bars of varying weight or strength, and lighter bars may be arranged singly or in groups near its pivotal support or near the supplemental breaker plate carried thereby.

The present improvements are preferably associated with a machine of the type set forth in my pending application, having grid bars which project into and/or entirely across the path of the feed above the rotor structure to temporarily support the material to be crushed; the hammers passing upwardly between said grid bars and initially engaging and breaking such material before it passes to the main crushing zone for final crushing by said hammers in cooperation with breaking elements, including the bars, carried by the cage or screen.

These and other features of my invention are more fully described hereinafter; reference being had to the accompanying drawings, in which:

Figure 1 is a cross sectional elevation, more or less diagrammatic in character, illustrating one form of hammer crushing mechanism with which the improvements

forming the subject of my present invention may be associated.

Fig. 1ª is a similar view on a reduced scale illustrating certain details of construction.

Fig. 2 is a rear elevation of a supplemental breaker plate which may be employed as a part of or associated with the cage or screen for cooperation with the hammers.

Fig. 3 is an elevation on a slightly larger scale, partly in section on the line III—III, Fig. 2; showing adjusting means associated with the supplemental breaker plate, and a breakable element associated therewith.

Fig. 4 is a sectional view on the line IV—IV, Fig. 3.

Fig. 5 is a view similar to Fig. 3 illustrating another form of adjusting means for the supplemental breaker plate.

Figs. 6, 7, 8 and 9 are diagrammatic views illustrating other forms of breakable supports for the supplemental breaker plate shown in Figs. 1 and 2, which may be associated with the cage or screen, permitting relief under excessive stress and avoiding undue damage to the crushing structure.

Fig. 10 is a sectional view illustrating a slightly modified form of spacing cross member for the cage or screen and a supplemental breaker plate associated therewith.

Fig. 11 is a view of a breaking element in the form of a weakened shear pin which may be employed in connection with the supporting means for the supplemental breaker plate, as shown in Figs. 2, 3, 4, 5, 6, 7 and 10.

Like the structure illustrated in my pending application before referred to, the present structure comprises a base 1, supporting a frame or housing, indicated generally at 1ª, which may be of structural metal and/or heavy cast parts suitably secured together and supporting the various elements making up the crushing structure and more fully referred to hereinafter.

A screen or cage 2, which may be made up of arcuate side members 3, supporting a series of bars 4, is disposed in the lower portion of the structure; such side members being pivotally supported at one end on a shaft 5, and adjustably supported at the opposite end; preferably by chains 6, passing over pinions 7, carried by a shaft 8. These chains may be adjusted as desired to elevate or lower the right hand end of the cage or screen (as indicated in Fig. 1) by imparting rotative movement to said shaft 8. The bars 4 may be of the type illustrated in my Patent No. 1,624,886, or like those shown in the co-pending application of Oscar Anderson, filed July 24, 1928, Serial No. 295,039. The shaft 5 supporting one end of the cage or screen, (at the left, as illustrated in the drawings), may be of the adjustable type, such as illustrated in the patent of Charles R. Rouse, No. 1,695,562.

Within the crushing chamber provided by the frame and the cage or screen and above the latter a hammer-carrying rotor structure is mounted, which may comprise a shaft 10, journaled in suitable bearings; end plates 12; (one of which is shown) a series of disks 13 arranged between said end plates; rods 14 passing through said disks and secured to said end plates, and hammers 15 which are pivotally hung on said rods 14. Hammer-carrying rotor structures of this general type are well known in the art and the hammers may be of any suitable type; preferably of massive and heavy construction, and they may have renewable tips in order that wear may be compensated for and fresh tips supplied without removing the shanks of the hammers from the suspension rods 14.

The hopper receiving the material to be crushed is indicated generally at 20, and is partly overhung by a curved breaker wall 21, forming one end of the crusher structure and preferably in the form of a reinforced frame of heavy construction, pivotally mounted on the shaft 5 supporting the cage or screen and having its inner and partially overhanging face provided with a series of renewable wear members 22, which may be secured to said frame by suitable bolts, indicated at 23.

For the purpose of retarding delivery of material into the crushing zone to a certain extent and effecting preliminary reduction by the hammers, a series of grid bars 25 are disposed in relatively fixed position in the hopper, and these grid bars may extend across the lower portion of the hopper, as shown in Fig. 1, or part way across as shown in Fig. 1ª. They lie in such position as to temporarily support the larger masses of material fed into the hopper while they are being acted upon by the uprunning hammers 15, until such larger masses have been reduced to a size that will permit passage through the spaces between the grid bars or beyond their ends (see Fig. 1ª), for further action by said hammers, cooperating with breaker members carried by the cage or screen including the bars 4, in the final crushing zone.

The side members 3 of the cage or screen may be connected together by cross members indicated at 3ª, 3ᵇ and 3ᶜ. In addition to the bars 4 which cooperate with the hammers, the cage or screen structures may include a breaking surface indicated at 45 and in some instances I may employ lighter bars 4ª (Fig. 1ª), disposed singly or in groups. A flanged cross member 47 connecting the ends of the members 3 serves to bridge the space between the bars 4 and a cross member 21ᵇ forming part of the frame.

Between the breaker plate structure or wall 21 of the hopper and the cross members or bars which are carried by the cage or screen I mount a supplemental breaker member 45ª, preferably provided with wear plates 50

whose active surface follows substantially the curve of the breaker wall 21 and in effect is a continuation of this breaking surface. This supplemental breaker plate more particularly shown in Figs. 2, 3, et seq., is hung from the rod or shaft 5 and may be adjustably connected with a cross member of the cage or screen preferably by breakable members associated with the means for supporting it in proper position with respect to the cage or screen, so that if any foreign, uncrushable material passes the grid bars 25 and is met by the hammers 15, in their effort to crush such material against such supplemental breaker plate, the latter may be temporarily displaced by rupture of the breakable connection with its supporting element; such supplemental breaker plate rocking on the shaft 5 without damage to the machine and permitting removal of the uncrushable object or mass.

The supporting means for the supplemental breaker plate may be associated with a member carried by the cage or screen; such parts being connected by a breakable element. Such member carried by the cage or screen may be a cross member 45 extending between the side members 3 and constituting an extension of the breaking surface of said cage or screen, or it may be the spacing cross member 3c extending between depending brackets of the said side members 3, or the cross member 46.

Various means of adjustably supporting this supplemental breaker plate or member may be provided and instances of such devices, together with breakable elements connecting the supporting means associated therewith are illustrated in Figs. 2, 3, 4, et seq., and more particularly referred to hereinafter.

The supplemental breaker plate or member 45a, illustrated in Figs. 1, 2, et seq., may be in the form of a heavy cast member having a substantially plain upper c- 'reaking surface, preferably provided with the wear plates 50, and a ribbed under surface, clearly shown in Fig. 2; such ribs, indicated at 51, constituting reinforcing means.

The supplemental breaker member illustrated in Figs. 2 and 3, is shown as pivotally connected by a shear pin 52, mounted in ears 53 intermediate its ends, with one end of a lever 54, pivotally supported at 55 by the cross-member 45, the opposite end of such lever being operatively disposed with respect to a yoke 56, pivotally connected at 56a to such cross member 45. The yoke 56 may carry a square-sectioned block 57, drilled eccentrically for the reception of and adjustment on the pin 56a mounted in said yoke, for engagement with the end 54a of the lever 54 to which the safety breaker plate element is pivotally connected by the shear pin 52; a set screw 54b being provided for holding the end of the lever 54 against said block in the adjusted positions of the latter. Adjustment of the block 57 serves to position the supplemental breaker plate 45a with respect to the path of the hammers 15; toward and from the same as crushing conditions may require. Should the presence of uncrushable material produce excessive stress upon the supplemental breaker plate, the shear pin 52 will be ruptured; allowing such supplemental breaker plate to drop against the cross-member 3c without other injury to the machine. It may be restored to place and supported in the desired position upon the insertion of a new shear pin.

In Fig. 5 I have shown other mechanism for adjusting the position of the supplemental breaker plate 45a, in the form of a segmental rack 59, under the control of a worm 60 hung from the cross member 45 and in operative engagement with said rack; a hand wheel 61 being provided for turning said worm. The segmental rack 59 may be pivotally hung at 62 from the cross-member 45, and may be provided with an extension 59a, apertured for the reception of a shear pin 52a, connecting the same with the supplemental breaker plate 45a.

Other means of supporting the safety breaker plate member may be employed, and in Figs. 6 and 7 I have shown shear pins 52b and 52c, for directly connecting said supplemental breaker plate with the cross-member 45. In these arrangements, the breaker plate will be provided with depending apertured ears 53a adapted to register with apertured ears 65 carried by the cross-member 45. The form of supplemental breaker plate illustrated in Fig. 6, is shown in position with respect to the other parts of the crusher structure, in Fig. 1. The form shown in Fig. 7, is substantially the same.

The form of supplemental breaker plate 45a, shown in Fig. 8, is provided with a flange 67, socketed at 67a for the reception of the end of a shear pin 68, which lies between the same and the cross-member 3c of the cage or screen. This pin 68 is of reduced cross-sectional area intermediate its ends, as indicated at 68a, and while affording a substantially stiff and efficient support during regular and normal operation of the machine, it will yield and fracture under abnormal stresses affecting the supplemental breaker plate. A substantially similar arrangement is illustrated in Fig. 9, wherein a curved bar 69, designed to break under excessive stress, is shown as disposed in substantially the same position and relation between the safety breaker plate 45a and the cross-member 3c, as the shear pin illustrated in Fig. 8.

In Fig. 10 I have illustrated a slight modification in the cage or screen construction, in which arrangement the grate bars 4 are shown as directly adjacent the supplemental breaker plate 45a; the latter being connected by a

shear pin 52[d] to a cross-member 46 secured to the side members 3 of the cage or screen.

The shear pins indicated at 52, 52[a], et seq., employed to connect the apertured ears of the respective parts illustrated in Figs. 2, 3, 5, 6, 7 and 10 may be of the type illustrated in Fig. 11; weakened at two points, as indicated at *x*.

A tramp iron pocket may be arranged at the right hand side of the machine, (as illustrated in Fig. 1,) just beyond the end of the cage or screen. At such part of the machine the cross portion 21[a] of the frame which extends between the side walls of the structure and serves as a support for the ends 25[a] of the grid bars 25 is arched, and receives a wear plate 71 which may extend part way into the crushing chamber; being notched at 72 for the passage of the hammers. An opening 73 is provided between the cross member 21[b] and said plate 71, and uncrushable material discharged through said opening 73 may drop onto the shelf provided by said cross-member 21[b]. It will be seen therefore that any tramp iron in the form of spikes, bolts, nuts and/or the like or other uncrushable material in the path of the hammers failing to pass between the bars 4 and which has been retained in the machine will be forcibly thrown against this arched wear plate 71 and be discharged from the crushing zone.

It will be understood, of course, that the several walls of the machine, including the hopper, will be provided with the usual wear plates, and that the side members 3 of the cage or screen will carry the usual shedding members designed to direct material being crushed into the path of the hammers for subsequent delivery through the spaces between the bars 4.

As in the machine of my pending application before referred to, the bottom of the feed hopper formed by the grid bars 25, cuts into the uprunning hammer circle at a point below the high point of the same; in other words, the uprunning hammers have an opportunity of impacting the stone on an upgrade for a considerable portion of the arc of the hammer circle, before the center or highest part of the hammer circle is reached. This is believed to be a distinctly advantageous feature of construction, as large pieces of stone or other material are retarded in going uphill and this additional time element gives the hammers better opportunity in the early stages, when the pieces of stone or other material are large, for the important and heavier preliminary breaking, so that when the uncrushed material gets up to the zenith or highest portion of the circle and starts downward at increased speed, it is better adapted, by reason of its size, to take the balance of the ride down hill to the left of the zenith, when its speed would be faster and where the lesser but no less important secondary crushing takes place. In other words, it seems distinctly better that the larger pieces of material particularly, which are the most difficult to reduce, are presented to the hammer circle on an upgrade and at slower speed, rather than at the top of the circle where they would be more rapidly carried into a down hill position. This condition would give the hammers less time to do the preliminary heavy crushing, which would mean that the material would enter the rapidly restricting zone between the hammers and the breaking surface of the wall or plate 21, in appreciably large sizes; thereby causing congestion of work in this restricted zone; reducing the chance for a complete and final reduction from the hammer action, with increased wear and shock to the machine, and the necessity of increased power because the total reduction period would be considerably increased.

I claim:

1. The combination, in a crusher of the hammer mill type, of a cage forming the lower part of the crushing chamber, a pivotal support for said cage, a rotor structure having hammers cooperating with said cage, a supplemental breaker plate disposed within the area of said cage and hung from the same pivotal support, means for holding said supplemental breaker plate in operative position, and means for adjusting the same toward and from the hammer circle.

2. The combination, in a crusher of the hammer mill type, of a pivotally mounted cage forming the lower portion of the crushing chamber, a rotor structure having hammers cooperating with said cage, a supplemental breaker plate pivotally mounted with respect to said cage on the same axis as the latter and disposed within the area thereof, means for supporting said supplemental breaker plate in operative position with respect to the hammer circle, and a breakable connection forming part of said supporting means.

3. The combination, in a crusher of the hammer mill type, of a cage or screen forming the lower portion of the crushing chamber, a rotor structure having hammers cooperating with said cage or screen, a supplemental breaker plate pivotally mounted with respect to said cage or screen, means for supporting said supplemental breaker plate in operative position and adjusting the same toward and from the hammer circle, and a breakable connection forming part of said adjusting and supporting means.

4. In a crushing machine, the combination with a frame having a hopper, a breaker wall structure pivotally connected to said frame and partly overhanging said hopper, a rotor structure in the lower portion of said frame carrying hammers, and means located in said hopper for retarding the passage of material to be crushed whereby said material may

be subjected to the action of said hammers while temporarily retarded, of a cage or screen adjustably mounted in the lower portion of said frame and below said overhanging breaker wall structure, and a supplemental breaker plate pivotally mounted with respect to the cage or screen and disposed below the main breaker wall and constituting a continuation of the same.

5. In a hammer crusher, the combination with a frame providing a crushing chamber, a pivotally mounted cage or screen in the lower part of the same having a series of grate bars through which the crushed material is delivered, a hopper delivering material into said chamber and an overhanging curved plate pivotally connected to the frame and forming one wall of said hopper, of a rotor structure within the crushing chamber having hammers, a series of fixed wear or breaker members carried by said curved plate which forms a portion of the delivery chute, and a supplemental breaker plate pivotally mounted below the curved wall of the hopper and forming substantially a continuation of the same.

6. In a hammer crusher, the combination of a frame having a crushing chamber, a screen or cage forming the bottom of said crushing chamber and through which the crushed material will be discharged, a rotor structure carrying hammers, an adjustable supplemental breaker plate associated with said cage and pivotally supported independently of the same, and means adapted to break under stress for maintaining said breaker plate in its normal position with respect to the cage or screen.

7. In a hammer crusher, the combination with a frame providing a crushing chamber, a pivotally mounted cage or screen in the lower part of the same having a series of grate bars through which the crushed material is delivered, a hopper delivering into said chamber, and an overhanging curved breaker plate pivotally connected to the frame and forming one wall of the hopper, of a series of grid bars forming the bottom of said hopper, a rotor structure within the crushing chamber having hammers; said hammers passing between said grid bars and into the hopper in their uprunning movement, and a supplemental breaker plate associated with the cage or screen and disposed below the curved wall of the hopper.

8. In a hammer crusher, the combination with a frame providing a crushing chamber and a pivotally mounted cage or screen in the lower part of the same having a series of spaced bars through which the crushed material is delivered, of a feed hopper having an overhung curved wall forming a continuation of the curve of the cage or screen and delivering into said crushing chamber, a series of grid bars forming the bottom of said hopper, a rotor structure within the crushing chamber having hammers; said hammers passing between said grid bars and into the hopper in their uprunning movement, and an adjustably mounted supplemental breaker plate hung from the pivotal support for the cage or screen and disposed below the overhung curved wall of the hopper.

9. In a hammer crusher, the combination of a frame having a crushing chamber, a screen or cage forming the bottom of said crushing chamber and having spaced bars through which the crushed material will be discharged, a rotor structure carrying hammers within the crushing chamber, a supplemental breaker plate pivotally supported independently of the screen or cage at one end of the same, adjustable supporting means for said supplemental breaker plate, and means adapted to break under stress for connecting said supplemental breaker plate with its adjustable supporting means in its normal position with respect to the cage or screen.

In witness whereof I have signed this specification.

GEORGE W. BORTON.