Sept. 30, 1941. R. P. FISHER 2,257,166

CRUSHER AND PULVERIZER

Filed April 21, 1939 2 Sheets-Sheet 1

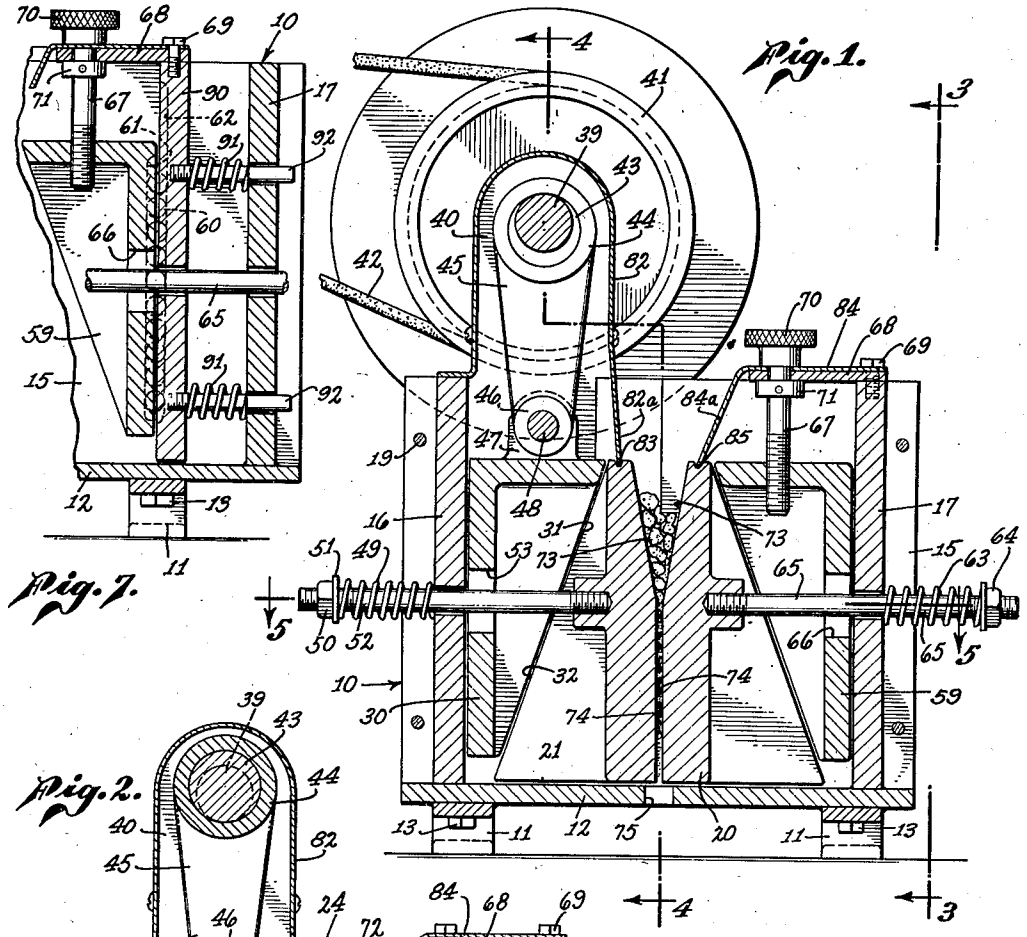


Fig. 1.

Fig. 7.

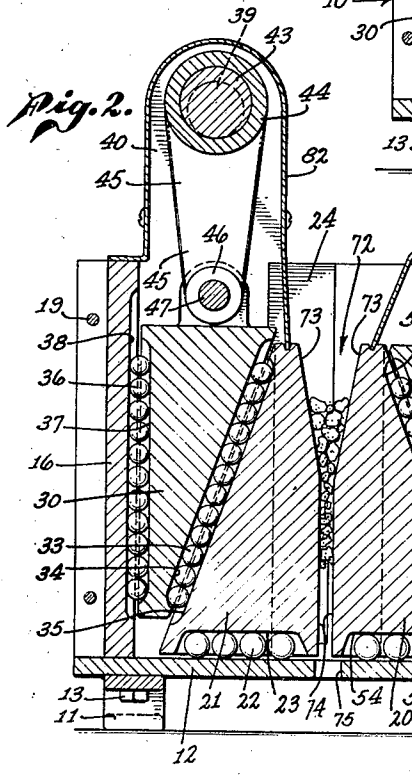


Fig. 2.

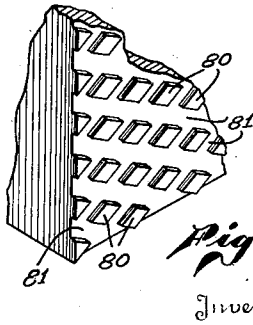


Fig. 6.

Inventor

ROBERT P. FISHER,

By Bernard Kriegel

Attorney

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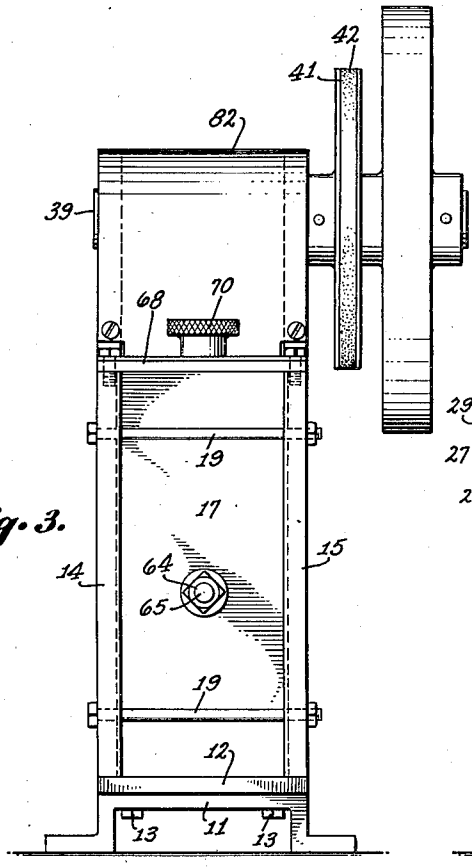


Fig. 3.

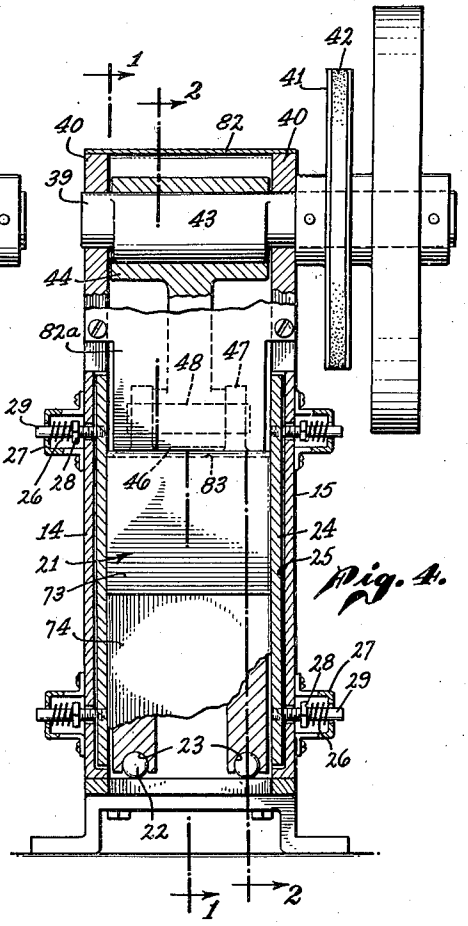


Fig. 4.

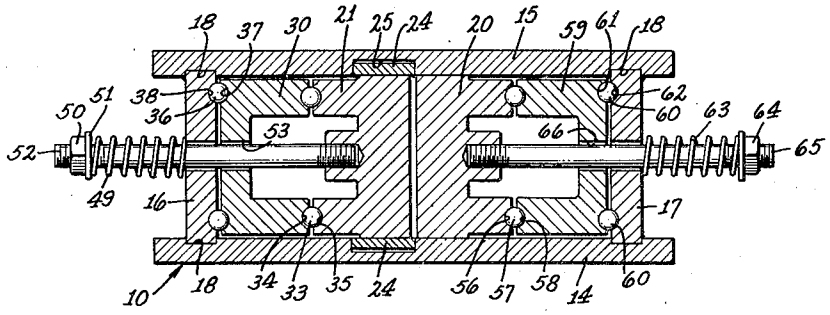


Fig. 5.

Inventor

ROBERT P. FISHER,

By Bernard Kriegel

Attorney

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UNITED STATES PATENT OFFICE

2,257,166

CRUSHER AND PULVERIZER

Robert P. Fisher, Los Angeles, Calif.

Application April 21, 1939, Serial No. 269,130

12 Claims. (Cl. 83—53)

The present invention relates to crushers and pulverizers, and more particularly to devices of that character employed in the crushing or pulverizing of various ores.

The prior art stamp mills, ball mills, crushers, pulverizers and the like reduce the size of the materials being operated upon with a full or partial grinding action. As a result, the percentage of material of desired mesh recovered is low, since such grinding action decreases the particle size of a large percentage of the material to an inordinately low value.

Accordingly, it is an object of the present invention to provide a machine capable of efficient crushing or pulverizing of materials, and in which the percentage of material reduced to a size less than that desired is substantially lowered.

It is a further object of the invention to provide a crusher or pulverizer capable of effective operation upon materials with substantially a complete omission of a grinding effect. That is, the invention contemplates the utilization of a full compressive force or impact upon the materials to reduce them by a shattering effect to the desired mesh.

Due to their inherent characteristics, the prior art crushing and pulverizing machines can operate only at slow speeds, and must be of large size with attendant weightiness and bulkiness to be able to act upon material at any given rate. It is still a further object of this invention to provide a crusher or pulverizer of relatively small size, but operable efficiently at a comparatively high speed to pass material therethrough at a correspondingly rapid rate.

This invention possesses many other advantages, and has other objects that will become apparent from a consideration of several embodiments of the invention. For the purpose of illustration, forms of the invention are shown in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limited sense, since the invention is best defined in the claims appended hereto.

Referring to the drawings:

Figure 1 is a longitudinal section of one form of the invention, taken generally along the line 1—1 of Figure 4, and disclosing the crusher jaws in contiguous position.

Figure 2 is a section taken generally along the line 2—2 of Figure 4, disclosing the crusher jaws in separated position;

Figure 3 is a side elevation as seen along the line 3—3 of Figure 4;

Figure 4 is a transverse section, taken along the line 4—4 of Figure 1;

Figure 5 is a cross section taken along the line 5—5 of Figure 1;

Figure 6 is an enlarged perspective view of a modified form of crusher member surface; and

Figure 7 is a modified form of part of the crusher.

The active parts of the crusher or pulverizer are suitably enclosed within a housing 10, supported upon base members 11 fastened to the bottom 12 of the housing by screws or bolts 13. The main portion of the enclosure 10 consists of front and back walls 14, 15, and side walls 16, 17 receivable within grooves 18 in the first-mentioned members. These parts are held together by bolts 19 passing through the terminal portions of the front and back walls. The bottom 12 is suitably secured to the wall members, as by welding or the like.

The material or ore is adapted to be crushed or pulverized by the application of a substantially full compressive force, alternately applied and released at a comparatively rapid rate. In accomplishing this objective, a relatively fixed crusher jaw 20 is mounted within the housing. Movable to and from this jaw, and preferably pursuing a straight line of motion, is a movable crusher jaw 21 rollable along the bottom 12 of the enclosure through the agency of the balls or rollers 22 received within a pair of spaced raceways 23 in the lower part of the jaw and engageable with the bottom 12 of the enclosure. The path of movement of this jaw 21 is confined by the engagement of its sides with the front and back walls 14, 15 of the housing.

As an assurance against damage to the housing, wear plates 24 are mounted within suitable recesses 25 extending between the top and bottom of the walls. These plates are urged into engagement with the bearing sides of the movable jaw by springs 26 abutting stationary brackets 27 fixed to the enclosure and against nuts 28 threaded onto stems 29 secured to the plates 24. By this arrangement, and due to the fact that the plates are made from softer material than the movable crusher jaw, any wear attending the operation of the crusher will occur upon the plates, instead of the jaw member, these plates being readily replaceable by the simple operation of removing the brackets 27 and threaded stems 29 prior to sliding the plates upwardly from the grooves 25 normally receiving them. The man-

ner of replacing the wear plates and securing their cooperable spring elements to them will be obvious.

The movable crusher jaw 21 is forced toward the fixed jaw by a slidable cam or wedge 30 having an inclined face 31 opposed to a companion inclined face 32 formed on the movable jaw. The cam or wedge 30 is slidable, preferably in a straight line at right angles to the path of movement pursued by the movable jaw, its motion being preferably transmitted to the movable jaw 21 through the medium of anti-friction ball or roller elements 33 receivable within the inclined spaced raceways 34, 35 provided respectively in the U-shaped cam and jaw arms extending toward one another. The cam 30, in causing movement of the crusher jaw member, will react against one of the side walls 16 of the enclosure through the anti-friction balls or rollers 36 engageable within spaced raceways 37 in the cam and corresponding opposed raceways 38 formed in the wall.

The cam 30 can be reciprocated by any suitable means. However it is proposed to employ the specific embodiment shown in the drawings, in which a drive shaft 39 is rotatably mounted within spaced supporting members 40 fixed to or integral with the front and back walls of the enclosure. This shaft fixedly carries a pulley 41 having an engaging belt 42 connected with another suitable pulley and source of power (not shown). An eccentric 43 is secured to the shaft for rotation therewith within the big end 44 of a connecting rod or pitman 45, whose other end 46 is received between bosses 47 extending upwardly from the cam or wedge member 30. A wrist pin 48 passes through the bosses and connecting rod to provide a pivotal connection between the latter member and the wedge.

It will be apparent that rotation of the eccentric 43 will produce reciprocation of the cam or wedge member 30 within the housing. Upon moving downwardly, the slidable cam will move the crusher jaw 21 towards the fixed jaw 20 in a path at right angles to that pursued by the wedge. Return movement of the movable jaw 21 to its initial position upon upward motion of the slidable cam is obtained by providing a return spring 49 having one end abutting the exterior of the side wall 16, and its other end a suitable nut 50 and washer 51 secured to a return rod 52 at its other end. This rod 52 passes through a slot 53 in the cam and is attached to the movable jaw, as by the threaded interconnection disclosed so that the tension or energy stored in the return spring is constantly tending to move the jaw 21 away from the fixed jaw 20 and also hold the various rolling elements 22, 33, 36 in engagement with their respective raceways. In view of the inclination of the cooperable raceways 34, 35 on the cam and movable jaw member, a component of thrust in a downward direction is always available for urging the movable jaw in a downward direction with its raceways 23 in snug bearing engagement with the bottom rows of rolling elements 22.

It is preferred that the position of the fixed jaw be made adjustable in order to vary the final mesh of the ore or other material passing between the jaw members of the crusher. Although various expedients could be availed of, the specific form shown in the drawings includes a structure similar to that described in connection with the movable jaw 21 and its cooperable cam or wedge 30. More specifically, the fixed jaw 20 is of generally U-shaped cross section, being provided with raceways 54 receiving rolling elements 55 engaging the bottom 12 of the enclosure and with tapered raceways 56 in its arms receiving balls or rollers 57 engageable within companion raceways 58 formed in an adjusting cam or wedge 59 adapted to react against the side wall 17 through the balls or rollers 60 received within pairs of spaced and opposed raceways 61, 62 provided in the adjusting cam 59 and inner surface of the side wall 17. The fixed jaw member 20 is urged away from the movable jaw 21 by a compressed spring 63 abutting the exterior of the side wall 17 and a nut 64 threadedly secured to a rod 65 extending through the side wall and an extended slot 66 in the adjusting cam 59, the rod being secured to the fixed jaw 20 by a suitable threaded interconnection. Adjustment of the fixed jaw is initiated through the rotation of an adjusting screw 67 rotatably mounted within a plate 68 fixed to the top of the enclosure by the screws 69. This screw 67 has a threaded stem received within cooperating threads provided in the top portion of the adjusting cam or wedge 59. Axial movement of the adjusting screw is prevented in one direction by the knob or wheel 70 abutting the upper surface of the plate 68, and in the other direction by a collar 71 fixed to the stem and abutting the underside of the plate.

Rotation of the adjusting screw 67 in one direction or the other will advance or retract the adjusting cam 59 to correspondingly position the fixed jaw 20 with respect to the movable jaw 21 and thus determine the minimum space remaining between the jaws after the movable member has approached to its greatest extent.

The material to be crushed or pulverized is fed to the convergent space 72 defined by the downwardly converging working surfaces 73 on the upper portions of the cooperable jaw members. The material will pass from this space between the parallel faces 74 on the remaining lower portions of the jaw members and will finally exit therefrom through an opening 75 in the bottom 12 of the enclosure. Within the convergent space, the ore will be given an initial crushing, reducing its mesh materially. Thereafter, the ore will pass between the parallel faces 74 of the jaw members for a final crushing and pulverizing to the desired mesh.

As the eccentric 43 rotates, the slidable cam or wedge 30 will be reciprocated fairly rapidly, inducing a corresponding reciprocation of the movable jaw member 21 toward and from the fixed jaw member 20. The rapidity of reciprocation of the movable jaw will produce a blow-like action upon the ore between the parallel faces of the jaws, to not only reduce it to the desired mesh determined by the adjusted position of the fixed jaw, but also to prevent free flowing or passage of the ore downwardly between the jaws under the influence of gravity. Instead of falling freely through the machine, the ore will only have time to be fed or gravitated step-by-step downwardly, being brought periodically to rest whenever the reciprocating jaw moves toward the fixed jaw and delivers a compressive force or blow to the material being acted upon.

Due to the substantially complete compressive action of the jaws upon the ore, very little of it is decreased in particle size to an inordinately low value, traceable to the substantial elimination of grinding action upon the ore. A high percentage of recovery of the ore at the desired mesh is

accordingly obtainable. This lack of extremely low fineness in the crushed or pulverized material is of particular value in connection with gold bearing ores. A grinding effect on such ores fails to free the valuable metals from the undesired elements, reducing the former to a flour state, from which their recovery is very difficult. Contrary to this result, the present invention delivers a shattering blow to the ore breaking the ganguey materials from the gold or other valuable elements, and leaving them in a state more readily recoverable.

The rapidity with which the present machine operates (for example, an eccentric speed of from approximately 1000 to 2000 R. P. M., although it is also effective at other speeds) permits a crushing effect to be effectively delivered to a much greater quantity of ore than can be reduced in prior art machines of comparable size. The crushing force delivered is very great due to the mechanical advantage afforded by the inclinations **31**, **32** of the slidable cam or wedge and the movable jaw member. It is to be understood that this mechanical advantage could be increased or decreased through appropriate alteration in the pitch of the inclined faces.

While comparatively smooth crusher surfaces can be effectively used, it might be desirable in operating upon damp ores to use roughened surfaces which will prevent sticking of the ore to the pressure plates and insure its downward feeding under the influence of gravity, in the manner aforementioned. The plate surfaces can consist of protuberances **80** (see Figure 6) separated by interstices **81**. The protuberances on each plate are preferably directly opposite one another to apply a compressive action or shattering blow to the material. Damp material will pass downwardly around the protuberances **80** or projections within the spaces **81** therebetween, and due to the intermittent progressive action thereon by following material will press the moisture out, leaving the ore in a desirable dry state and of the required mesh.

The projections or protuberances **80** are preferably of diamond shape with those on one jaw surface positioned substantially at right angles to the opposed projections on the other jaw surface. In this manner, the protuberances will overlap the intervening spaces on the other jaw member to apply an effective compressive action to the materials within the interstices for the purpose of both pulverizing and drying them. Although I do not wish to be limited to this figure, good results have been obtained with a provision of about six protuberances to the inch upon the jaw surfaces.

The material or ore is prevented from coming in contact with the bearing surfaces and rotating parts of the device by providing a flexible shield **82** around the eccentric, and connecting rod, which shield has an end **82***a* seating within a groove **83** in the upper part of the movable jaw. Another flexible shield **84** is fastened to the top plate **68** of the adjusting device with one of its ends **84***a* seating within the groove **85** provided in the upper portion of the stationary jaw member.

A yieldable reaction plate for the fixed jaw member **20** can be provided as a safeguard against jamming of the machine in the event that non-friable material, such as pieces of iron or steel, comes between the jaw members. As disclosed in Figure 7, a member **90** having raceways **62** for the reaction rolling elements **60** abuts a plurality of stiff coil springs **91** bearing against the side wall **17** and held in position by retainer studs **92**. The springs **91** function normally as rigid abutments for the reaction member **90**, but are of such strength as to yield upon an overload occurring between the jaw members, due to relatively non-friable material coming therebetween. In this form, the top plate **68** and adjusting screw **67** are carried by the member **90**.

I claim:

1. A device of the character described, including a supporting structure, jaw members having opposed vertical faces for crushing materials therebetween, one of said members having a bearing raceway inclined upwardly toward said other jaw member, a reciprocable cam having a companion raceway, said structure having bottom horizontal and side vertical raceways opposite respective bottom and side raceways in said inclined jaw member and cam, rolling elements in said raceways, whereby vertical reciprocation of said cam moves said inclined member horizontally with respect to said other jaw member for guiding said inclined jaw member to and from said other jaw member, comprising wear plates in said structure, and means for yieldably engaging said plates with said jaw member.

2. A crusher, including a stationary jaw member, a movable jaw member, said members having opposed vertical faces for crushing materials therebetween, said movable member having a bearing portion inclined to the vertical, a reciprocable cam having a companion inclined portion for moving said movable jaw member horizontally in a straight line path with respect to said stationary jaw member, said stationary jaw having a portion inclined to its vertical face, an adjustable cam in slidable relation with said inclined portion, a rotatable screw threaded shaft cooperable with said cam for shifting it with respect to said stationary jaw to determine the minimum space between said jaw members, a rod fixed to said stationary jaw member and extending through a slot in said adjustable cam, and spring means acting on said rod to urge said stationary jaw member away from said movable jaw member.

3. A crusher, including a stationary jaw member, a movable jaw member, said members having opposed faces for crushing materials therebetween, said movable member having an inclined bearing portion, a reciprocable cam having a companion inclined portion for moving said movable jaw member in a straight line path with respect to said stationary jaw member, said stationary jaw having an inclined bearing portion, an adjustable cam in slidable relation with said inclined portion, a feed screw cooperable with said adjustable cam for shifting it with respect to said stationary jaw to determine the minimum space between said members, and means for yieldably urging said jaw members apart.

4. A crusher, including a stationary jaw member, a movable jaw member, said members having opposed faces for crushing materials therebetween, said movable member having an inclined bearing portion, a reciprocable cam having a companion inclined portion for moving said movable jaw member in a straight line path with respect to said stationary jaw member, said stationary jaw having an inclined bearing portion, an adjustable cam in slidable relation with said inclined portion, a feed screw cooperable

with said adjustable cam for shifting with respect to said stationary jaw to determine the minimum space between said members, a rod fixed to said stationary jaw member and extending through a slot in said adjustable cam, and spring means acting on said rod to urge said stationary jaw member away from said movable jaw member.

5. A crusher, including a supporting structure, jaw members having opposed faces for crushing materials therebetween, each of said members having an inclined bearing raceway, a slidable cam for each member having a companion raceway, said structure having bottom and side raceways opposite respective bottom and side raceways in said jaw members and cams, and rollable elements in said raceways.

6. A crusher, including a supporting structure, jaw members having opposed faces for crushing materials therebetween, each of said members having an inclined bearing raceway, a slidable cam for each member having a companion raceway, said structure having bottom and side raceways opposite respective bottom and side raceways in said jaw members and cams, rollable elements in said raceways, and means for yieldably urging said jaw members apart to maintain said elements in their respective raceways.

7. A crusher, including a supporting structure, stationary and movable jaw members having opposed vertical faces for crushing materials therebetween, said movable member having a bearing portion inclined to the vertical, a reciprocable cam having a companion inclined portion for moving said movable jaw member horizontally in a straight line path with respect to said stationary jaw member, said stationary jaw having a portion inclined to its vertical face, an adjustable cam in slidable relation with said inclined portion, said structure having horizontal bottom and vertical side raceways opposite respective horizontal bottom and vertical side raceways in said jaw members and cams, said inclined portions having respective opposed raceways, rollable elements in said raceways, and means cooperable with said adjustable cam for shifting it with respect to said stationary jaw to determine the minimum space between said members.

8. A crusher as defined in claim 7, including means for yieldably urging said jaw members apart to maintain said rollable elements in their respective raceways.

9. A crusher as defined in claim 7, including a rod fixed to said stationary jaw member and extending through a slot in said adjustable cam, and spring means acting on said rod to urge said stationary jaw member away from said movable jaw member.

10. A crusher, including cooperable stationary and movable jaw members having opposed faces for crushing materials therebetween, said members having bearing portions inclined upwardly toward each other, opposed similar slidable cams each having an inclined bearing portion companion to the inclined bearing portions of an adjacent jaw member, means for shifting said cams to move said members toward each other, and separate means for yieldably urging said jaw members away from each other.

11. A crusher, including cooperable stationary and movable jaw members having opposed vertical faces for crushing materials therebetween, said members having bearing portions inclined upwardly toward each other, a reciprocable cam having a bearing portion companion to the bearing portion on said movable jaw members for moving the latter horizontally in a straight line path towards said stationary member, an adjustable cam having a bearing portion companion to the bearing portion on said stationary jaw members for shifting the latter horizontally in a straight line path toward said movable member, a rod secured to each jaw member and extending through a slot in the adjacent cam, and a spring acting on each rod for urging its attached jaw member away from the opposed jaw member.

12. A crusher, including cooperable stationary and movable jaw members having opposed faces for crushing materials therebetween, said members having bearing portions inclined upwardly toward each other, opposed similar slidable cams each having an inclined bearing portion companion to the inclined bearing portion of an adjacent jaw member, means for shifting said cams to move said members toward each other, separate means for yieldably urging said jaw members away from each other, a flexible shield attached to the top of said movable jaw member and extending upwardly to exclude foreign matter from said inclined bearing portions, and an opposed shield extending upwardly from said stationary jaw member, said shields cooperably forming a hopper for directing material between said faces.

ROBERT P. FISHER.