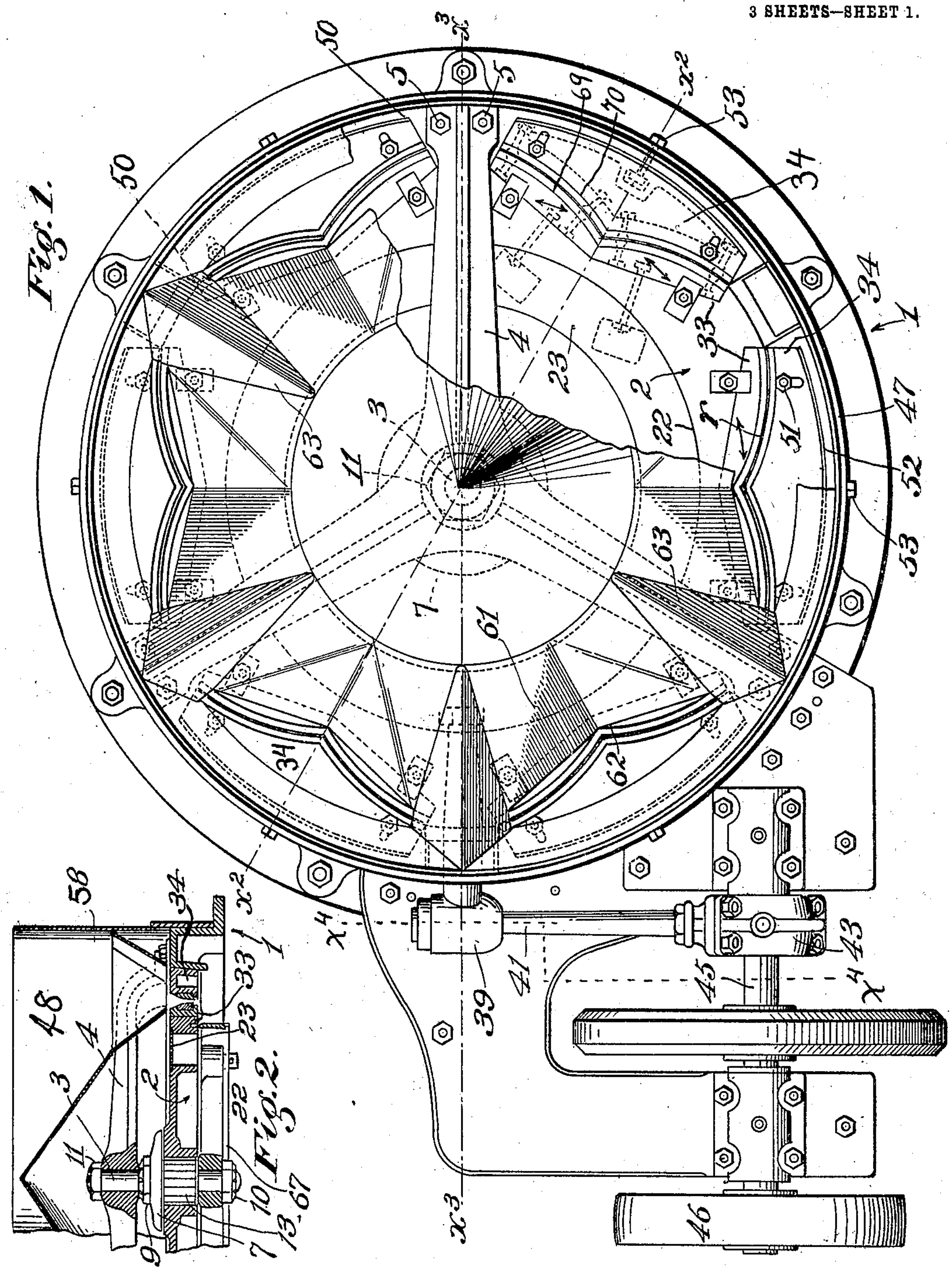
No. 827,879. PATENTED AUG. 7, 1906.

F. NEWNHAM.

ROCK SPLITTING MACHINE.

APPLICATION FILED NOV. 17, 1905.

3 SHEETS—SHEET 1.



Witnesses:

C. C. Holly

Chester H. Roakes

Inventor,

Frank Newnham.

by James R. Townsend

his Atty.

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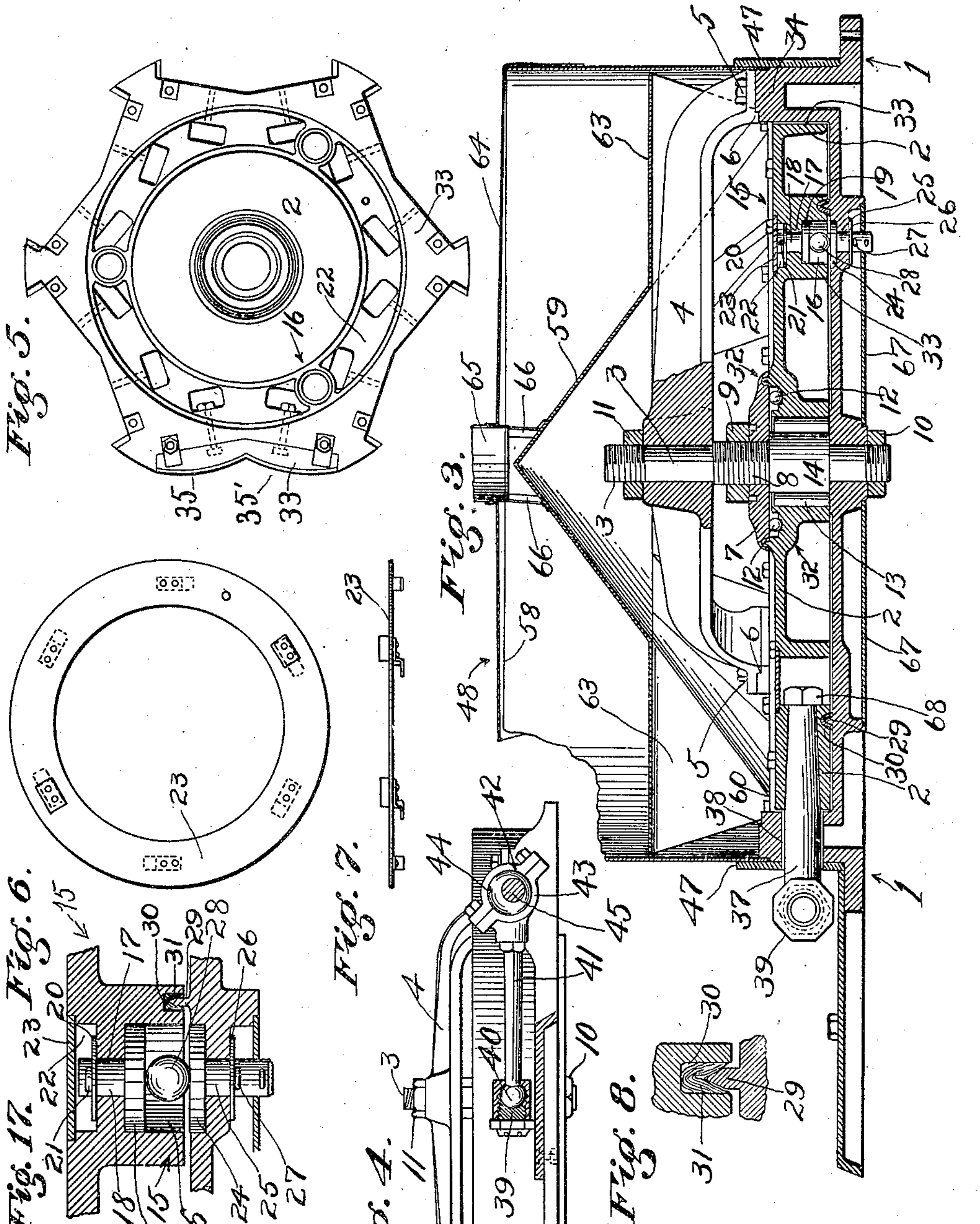

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3 SHEETS—SHEET 3.

Fig. 9.

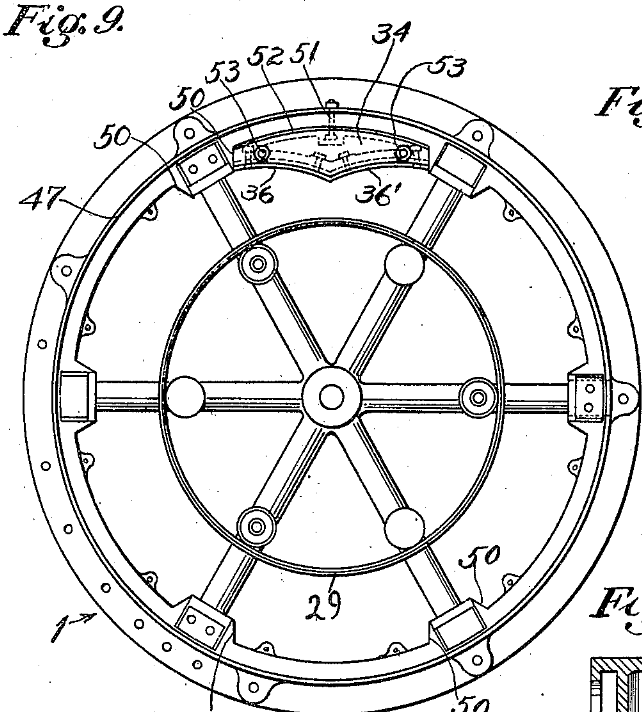


Fig. 10.

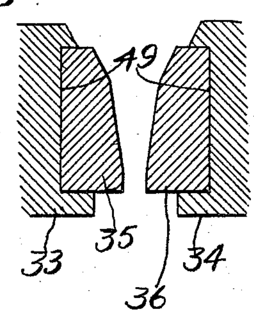


Fig. 13.

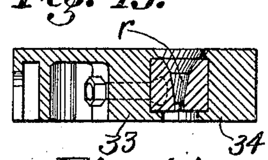


Fig. 11.

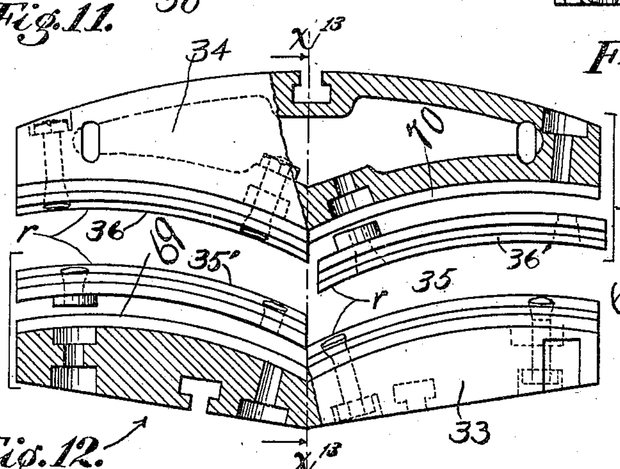


Fig. 12.

Fig. 14.

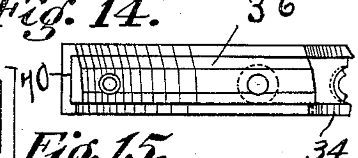
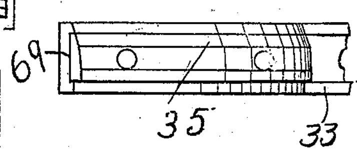


Fig. 15.



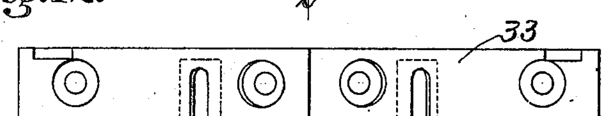


Fig. 16.

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UNITED STATES PATENT OFFICE.

FRANK NEWNHAM, OF LOS ANGELES, CALIFORNIA, ASSIGNOR TO FIRST MILL COMPANY, OF LOS ANGELES, CALIFORNIA, A CORPORATION OF CALIFORNIA.

ROCK-SPLITTING MACHINE.

No. 827,879. Specification of Letters Patent. Patented Aug. 7, 1906.

Application filed November 17, 1905. Serial No. 287,761.

To all whom it may concern:

Be it known that I, FRANK NEWNHAM, a citizen of Great Britain, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Rock-Splitting Machine, of which the following is a specification.

The primary object of this invention is to provide a machine which will break the rock in such manner as to produce a uniform granulation thereof without pulverizing any substantial part to dust or slime.

An object of this invention in this connection is to take advantage of the comparative facility with which most rocks will break along planes of least resistance if subjected to shearing strains in such planes. Crushers acting by direct pressure necessarily act on the rocks at indiscriminate angles relatively to such planes and require the expenditure of correspondingly great power and do not produce uniform results. If a grinding action is involved, powders or slimes are produced with waste of powder and excessive wear on the jaw-plates; but if the rock be placed between two substantially parallel surfaces which are caused to approach one another by an oblique movement whose principal component is parallel to said surfaces, but whose component transverse to said surfaces is sufficient to prevent sliding of the rock, the rock will be subjected to a wrenching, twisting, tearing strain, and, yielding in the direction of least resistance, will be split along the planes thereof with less power than would be required for grinding or for direct crushing at an indiscriminate angle relatively to the plane of cleavage or other plane of least resistance. Moreover, the splitting of the rock will in general be clean and unaccompanied by dust or powder. This invention is directed to splitting rock in this special manner, and to get the full advantages thereof it is preferable to operate in such manner that the machine splits or cracks off each particular piece of rock without any grinding action, the piece then immediately passing from the machine. When so operating, the effect of each splitting operation will be roughly to divide the rock from pieces of given size to pieces of substantially half that size, and by a series of such operations in successive machines, as explained in detail below, the size of the pieces may be reduced step by step until a given size of granulation is reached.

A further object of the invention is to secure to the fullest extent the mineral values of ores. Such values generally lie in matrices and along planes of cleavage, and by the splitting operations above described the values are to the fullest extent exposed and the compacting or grinding of the same into the rock material or gangue is obviated.

Another object of the invention is to construct a machine which will break, divide, and granulate rock in the above-described manner with a minimum of frictional resistance on the working parts. In this connection it is preferable to construct the machine in such manner that the pressure upon each portion of rock is balanced as regards the machine by pressure upon another portion of rock, so that lateral pressure upon the bearings or support in the machine for the moving parts is substantially obviated.

Other objects of the invention relate to provision for separability and renewal of wearing parts and to the general simplification of the machine.

This invention comprises two jaw members of a general circular shape with opposing longitudinally-curved operating-faces, the elements in the trace of the plane which intersects one face horizontally extending substantially parallel with the elements in the trace of the same plane where it intersects the other face and means for causing a relative movement between said faces, whereby the change of position of one face relative to the other takes place along a path which is diagonal relative to the faces, the ratio of the components of said movement, supposing one of the components normal to the working face, being one of direct perpendicular approach to two of movement along the curves of the working faces, this action being attained by properly disposing the working faces with respect to each other and with respect to the center of partial revolution of the movable working face, being approximately one of approach or recession to two of longitudinal travel.

In said machine inner and outer star-shaped jaw members are provided, respectively, with external and internal faces, the projecting portions of the inner star-shaped members extending within the corresponding portions of the outer star-shaped members and diametrical dimensions of the inner star-shaped member being less than that of the corresponding dimensions of the outer star-shaped member to leave between them an opening for the passage of material to be reduced and means for causing relative pivotal movement between said members.

In this application I show the said machine as improved through years of experiment for practical use, the same being of a simple and satisfactory character, having few parts, easily constructed, assembled, and taken apart, strong in construction, and adapted to provide means for producing a uniform product for a long period without replacing the jaws and with long life of the wearing parts.

It is to be understood that this invention is applicable for both dry and wet reduction of ore.

An object is to so construct the device as to allow the jaw-seats and jaws to be machined, and thus accurately fitted together, also to provide for replacing worn parts at minimum expense.

The accompanying drawings illustrate the invention.

Figure 1 is a plan of a rock-splitting machine embodying this invention in its preferred form. A portion of the hopper is broken away to expose parts that would be concealed thereby. Fig. 2 is a reduced fragmental section on line x^2 x^2, Fig. 1, showing the hopper in place and omitting the shims that are shown in Fig. 1. Fig. 3 is a section on line x^3 x^3, Fig. 1. Fig. 4 is an elevation of the machine from the left of Fig. 1 in section on line x^4 x^4. Fig. 5 is a plan of the inner jaw-frame, one set of inner jaw-plates being shown in place. Fig. 6 is a plan of the annular plate which has been removed from the annular channel shown in Fig. 5. Fig. 7 is a side elevation of the annular plate shown in Fig. 6. Fig. 8 is an enlarged detail illustrating the dust-guard. Fig. 9 is a plan of the outer jaw-frame, the inner jaw being removed. Fig. 10 is a section of the outer and inner jaw working faces in working position. Figs. 11 and 12 are details illustrating working-face seats of the outer and inner jaw members and their working faces, each seat being shown with one working face attached and the other detached, portions of the seats being sectioned. Fig. 13 is a sectional elevation on line indicated by x^{13} x^{13}, Figs. 11 and 12, showing working-face seats in appropriate relation to each other with the working faces in place. Fig. 14 is a view showing the ore-contacting side of an outer working face and its jaw, a portion of which is shown. Fig. 15 is a view of an inner working face and its jaw, a portion of which is shown. Fig. 16 is an elevation of the back of a working-face seat of the inner jaw, the same being that portion of the inner jaw which is in the lower part of the view of Fig. 11. Fig. 17 is a detail of the arrangement for ball-bearing between the two jaws.

In a general way, 1 designates the outer jaw; 2, the inner jaw, mounted in the outer jaw; 3, a vertical center shaft stepped in the outer jaw; 4, a spider supporting the outer end of the shaft and secured to the rim of the outer jaw by bolts 5 and a heel 6, which is notched into said rim.

7 is a thrust-plate screwed on a step 8 on the center shaft 3 and secured by a nut 9, likewise screwed upon said step.

10 is a nut screwed on the bottom of the shaft 3 to fix the same in the outer jaw, and 11 is a nut screwed on the top of the shaft against the spider to hold the spider in place, thus giving perfect rigidity to the connection between the outer jaw, spider, shaft, and thrust-plate.

12 is an antifriction ball-bearing between the thrust-plate 7 and the inner jaw.

13 is an antifriction roller-bearing between the inner jaw and cylindrical step 14 on the center shaft 3.

15 in a general way designates an antifriction-bearing between the outer and inner jaw, for which purpose the inner jaw is provided with a recess 16 on its under side and with a perforation 17, through which a stem 18 extends from the recess 16. 19 is a bearing-plate on said stem 18, seated in the top of the recess 16. 20 is a washer around said stem, and 21 a pin through said stem 18 and resting on the washer to hold the bearing-plate 19 in place.

A plurality of antifriction-bearings, preferably three, is provided for the web of the inner movable jaw to form rolling points of support to carry the weight of the jaw.

22 designates an annular channel in the top of the jaw, in which the stems 18 of the bearing-plates are mounted. 23 is an annular plate forming a cover for said channel, thus to exclude dust from the bearing-plate.

24 is a bearing-plate similar to plate 19, held by a stem 25, which is secured by a washer 26 and a pin 27.

28 is a ball mounted in the recess 16, which is preferably circular to form a limited way for the antifriction-ball 28.

29 is an annular bead on one of the jaws extending into an annular recess 30 in the other jaw. 31 designates packing in said recess and engaging the annular bead 29 to prevent the entrance of dust which might otherwise reach the bearings between the outer and inner jaw. The thrust-plate 7 forms part of a like arrangement for protecting the antifriction-bearings 12 and which arrangement is designated in a general way by the character 32.

The jaws are mounted for relative pivotal movement and are respectively composed of several parts, two of which are particularly designated, respectively, as the working-face seats 33 34 of the inner and outer jaws. In the form shown in the drawings the inner jaw is horizontally vibratory relative to the outer jaw on the vertical axis at 3. Said jaws are respectively provided with opposing coacting faces formed by working-face members 35 35′ and face members 36 36′, spaced apart from and extending obliquely to the path of the working face 35 35′ of the vibratory member or inner jaw 2, which path is indicated by double-headed arrows in Fig. 1, although it is to be understood that the travel of said face members is very limited, varying in the different machines according to the open space between the working-face members of the outer and inner jaws—that is to say, where a machine is designed to reduce pieces of rock having the maximum size to go through a two-inch ring, making a product of the maximum size to go through a one-inch ring, the vibratory travel of the working face should be approximately five-sixteenths of an inch, while the travel of such faces for machines designed to take in pieces of maximum size to go through a one-inch ring and to discharge pieces of a maximum size to go through a half-inch ring will be approximately seven thirty-seconds of an inch, and in the size below in which the product is in pieces to go through a one-fourth-inch ring the vibratory travel or path of said working faces will be approximately five thirty-seconds of an inch. The curved working faces are plain—that is to say, smooth where they contact with the rock—as indicated in Figs. 10, 11, 14, and 15. The contours of said coacting faces at successive levels are approximately parallel, said faces being grouped around the pivotal point and formed in the plane of movement as arcs of circles eccentric to the center of relative pivotal movement of the jaw members, adjacent faces abutting to form internal angles on one jaw and external angles on the other, respectively.

The vibratory movement is imparted to the inner jaw in the form shown by a tapered shaft 37, which passes through a hole 38 in the outer jaw and has on its end a socket 39, in which a ball 40 on the end of a pitman 41 is fitted to work. Motion is imparted to the pitman by a ball-and-socket eccentric 42, in which eccentric-strap 43 is on the pitman and is concave to fit the eccentric-ball 44, which is on the shaft 45, to which power would be imparted through the pulley 46.

The outer jaw 1 is provided with a steel band 47, which projects upward above the top of the jaws to form a seat for the rim of the hopper 48.

Means are provided for adjusting the width of the space between the working-face members. In this relation 49 designates seats for the working-face members 36 36′ of the outer jaw. 50 designates ways provided in said outer jaw, in which said seats are adjustable toward and from the axis 3, on which the vibratory member 33 is pivoted, and suitable means are provided for adjustably fastening the seats in said ways. 51 designates bolts and nuts, 52 shims, and 53 binding-screws for this purpose.

The hopper 48 comprises a cylindrical hoop 58, a central cone 59, the base 60 of which is provided with a fluted skirt 61, recessed at 62 to approximately conform to the inner working jaw-faces and extending in shields 63 over the spider-arms and the spaces between the sets of jaw-faces 35 35′ and 36 36′.

64 is a canvas cover supported at the edge by the hopper-hoop 58 and at the center by a chute 65, through which the ore is fed and which is supported by legs 66.

67 is a plate extending underneath to prevent the dust from rising into the machine. The cover 64 prevents the dust from rising from the hopper.

68 is a nut detachably fastening the taper shaft 37 into the inner jaw 2.

The shims 52 are employed for the purpose of adjusting the jaw-seats to a greater or less distance from the axis of vibration, and the same in some instances may be omitted. Said shims are omitted in Fig. 2, but are shown in Fig. 1.

Each of the seats 33 34 for the working-face members is carried in a way, as 50, and held in place by bolts and screws 51 53 in its respective jaw member and is formed with non-concentric grooved facets, as 69 70, and the working faces 35 35′ 36 36′ are placed in said grooved facets. Each jaw is provided with one or more pairs of non-concentric working faces, and the opposing working faces of the jaws are arranged in approximately concentric pairs, the curved faces of which are eccentric to the center of partial revolution of the movable jaw.

It is evident that while it is necessary that there be a relative movement between the jaws it is immaterial as to which (the inner jaw, the outer jaw, or both jaws) are made movable. The form shown in the drawings is the simplest and best form in which I have contemplated carrying out the invention. The relative jaw movement need not be very great—in fact, is quite slight—and the components of the relative movement of any two points that may simultaneously engage the same piece of rock to grip it between them will be approximately in the ratio of one of approach or recession to two of relative longitudinal travel and will be oblique relative to the opposing outer and inner jaw-faces. The object of this is to effect the wrenching, twisting, or cracking action with that degree of compression only which is necessary to follow up the change of form caused by said wrenching and breaking.

In practical operation the ore or other material to be disintegrated will be fed through the chute 65 into the hopper 48, whence it passes into the open spaces between the jaw-faces all around the machine. The material thus fed into the receiver should be previously broken to a size which will allow the fragments to come between the operating-faces of the jaws, where they will be operated upon and cracked or split between the approaching jaw-faces until the limit of the movement in that direction is reached, and at the same time the jaw-faces which are receding will allow other material to fall down further between the operating-faces, and at the next movement the spaces between the operating-faces which at first approach will be widened, while the space between the faces which at first receded from each other will be narrowed, thus allowing the material between one-half of the opposing faces to feed, while the material between the other half of the opposing faces will be acted upon and broken. Furthermore, the pressure upon the material to be broken at one side of the machine will tend to force the jaws apart at that side of the machine; but at the same instant a like operation will be occurring on the opposite side of the machine.

The mounting of the jaws upon each other and upon the vertical shaft 3 is such that there is no looseness except what is necessary for the required pivotal movement of the jaws; but such freedom of movement allows the pressure to be transmitted through the jaws from the material on the one side to the material on the other side, so that the crushing action is not applied as a force upon the bearings, but is borne by the material to be disintegrated, greatly increasing the effectiveness of the machine.

As the opposing jaw-faces converge downwardly they are not parallel vertically, but the elements in the traces of horizontal planes which intersect both of said surfaces in the direction of their lengths or the greatest relative movement of said faces are substantially equidistant throughout, and therefore the rock that is placed between these surfaces will be subjected to the same twisting and splitting action as would occur if placed between straight parallel surfaces.

The object of the downward convergence of the jaws or opposing faces is to insure that rock of a certain minimum size will not fall through, but will be subjected to the action of the jaws, and the opening or distance at the bottom between the jaws is sufficient to insure that each piece of rock as soon as it has been split by one operation of the jaws will fall through said opening on the next successive retractive movement of the jaws. This effect is attained by making the lower opening or distance between the jaws substantially one-half of the upper opening or distance.

Horizontal elements of the opposing coacting faces are in this sense approximately parallel, and in order to maintain said parallelism in a machine such as that shown, in which members or jaws which carry said faces have a relative pivotal movement, it is necessary that said coacting faces be arranged or formed in curved lines forming arcs *r*, respectively, drawn from centers eccentric to the center of relative pivotal movement of the jaws, said arcs intersecting the arcs of travel of the said faces. This curvature is determined empirically according to the dimensions of the machine. It is obvious that with flat faces the relative angular deflection of the parts in the pivotal movement would destroy the parallelism of the movement, and it is only by curving the faces in a certain manner, as specified, that such parallelism can be maintained. The approach and recession of the jaws by a movement one-half that of the relative longitudinal movement which is essential to produce splitting in counterdistinction to crushing or grinding is obtained by properly disposing said faces as regards the angle which they make with their direction of movement. If the faces were parallel with the direction of movement, there would be no approach or recession, and if they were at right angles to the direction of movement there would be no relative longitudinal movement; but the movement would be one of direct approach and recession. Between these two extremes the angle may be selected to give any desired ratio of approach and recession to that of longitudinal movement, and the angle discovered to be necessary in this case is that which will give a ratio of approximately one to two, as specified.

The operating-faces on both the inner and outer jaws are arranged in circular series or order—that is to say, the operating-faces on each of said members extend around the center of relative pivotal movement of the members, the ring or series of jaw-faces being star-shaped, the diametral dimensions of the inner star-shaped member being less than the corresponding dimensions of the outer member, so as to leave between them an opening for the passage of material from the machine. Moreover, the operating-faces of each jaw member are arranged in diametral opposition to corresponding faces on the other side of the center of relative pivotal movement, so that the pressure exerted toward the center by the operation of each jaw-face is opposed by a corresponding pressure exerted by the jaw-face on the other side of the machine.

It is apparent that when the space between any two of the opposing faces is widened by the recession of one or both of the faces from each other the broken material between them will fall, and all the material which is sufficiently broken to pass through the space between the jaws will fall down through the open spider-like base 1, where it may be taken by screens and conducted to other similar machines for reduction to smaller size.

In order to secure the greatest capacity for any given size of machine and also to avoid crushing to a powder any particles after the material has been once split, as above described, the opposing coacting faces of the jaws are constructed of such slant or angle that the discharge-orifice at the bottom of the faces is approximately one-half the width of the receiving-opening at the top, so that the material will fall through as soon as it has been split.

The object of connecting the jaws with the eccentric by ball-and-socket joints is to allow the necessary rotation of the jaw and to avoid any heating of the journals which may be occasioned by any lack of adjustment or lining up of the parts of the machine. By providing a ball-and-socket connection between the pitman and the jaw such difficulty is obviated.

What I claim is—

1. A rock-splitting machine provided with outer and inner jaws, one of which is horizontally vibratory on a vertical axis; opposing working-face members for said jaws respectively spaced apart and extending obliquely to the path of the working-face member of the vibratory jaw member; seats for said working-face members; ways being provided in which said seats are adjustable toward and from the axis on which the vibratory member is pivoted; and means for adjustably fastening the seats in said ways.

2. Two jaws, one being adapted to vibrate relative to the other on a vertical axis, bearing-plates for said jaws mounted on stems which extend through the jaws respectively, means for securing said stems in the jaws, and a bearing-ball between the bearing-plates and inclosed by the jaw.

3. Jaws, one of which is arranged to vibrate relative to the other on a vertical axis, bearing-plates for said jaws provided with stems extending through the jaws respectively, annular seats being formed in said jaws opposite the bearing-plates, and annular plates in said annular seats for excluding dust from said bearing-plates.

4. In a rock-splitting machine, a jaw provided with a way, a seat for working-face members carried therein, said seat being formed with non-concentric grooved facets at one edge; and detachable working-face members seated in said facets.

5. In a rock-splitting machine, a jaw provided with a way, a seat for working-face members carried therein, said seat being formed with obliquely-arranged grooved facets at one edge, each of the facets having a recess in the bottom of its groove; and detachable working-face members for said groove, each provided with a lug to enter a recess.

6. In a rock-splitting machine, an annular jaw, working-face members for said jaw, detachable seats for said face members each converging from its middle toward its ends, the outer edge of said seat being in the arc of a circle, and the inner edge being grooved in two arcs joining midway of the seat, the working-face members being seated in said grooves, and conformed to each other at their joining ends.

7. In a rock-splitting machine, an annular jaw, working-face members for said jaw, detachable seats for said face members each converging from its middle toward its ends, the outer edge of said seat being in the arc of a circle, the inner edge being grooved in two arcs joining midway of the seat, the working-face members being seated in said grooves, and conformed to each other at their joining ends, recesses being formed in the groove near the middle of the seat, and said working faces being provided with lugs to fit said recesses.

8. A seat for working-face members of a rock-splitting machine comprising a body wider in the middle than at its ends and provided with a cavity in its under side, working-face members for one edge of said seat, said working-face members abutting against each other at the middle of said seat, bolts through said working faces and the ends of said seat, and bolts extending through the working faces and into the cavity of the middle of said seats.

9. A rock-splitting machine provided with two jaws one within the other, one of said jaws being pivoted, jaw-faces on opposite sides of the pivotal point of said pivoted jaw arranged with arc-shaped spaces between them, and a hopper comprising a cone provided with a fluted skirt constructed to direct material into said spaces.

10. In a rock-splitting machine, the combination of two jaws mounted for relative pivotal movement and having opposing coacting faces, the contours of which at successive levels are approximately parallel, said faces being formed in a plane of movement as arcs of circles, eccentric to the center of relative pivotal movement of the jaws, adjacent faces abutting to form internal angles on one jaw and external angles on the other, respectively, and means for causing relative pivotal movement of said jaws.

11. In a rock-splitting machine, the combination of two jaws mounted for relative pivotal movement and having opposing coacting faces, the contours of which, at suc-

cessive levels are approximately parallel, said faces being formed in the plane of movement as arcs of circles, eccentric to the center of relative pivotal movement of the jaws, adjacent faces abutting to form internal angles on one jaw and external angles on the other, respectively, the internal angles of one jaw embracing the external angles of the other jaw, and means for causing relative pivotal movement of said jaws.

12. In a rock-splitting machine, the combination of two jaws having a relative pivotal movement, each of said jaws provided with curved operating-faces on opposite sides of the center of relative pivotal movement, and the faces of each of said jaws forming alternate internal and external angles, the internal angles of one jaw embracing the external angles of the other jaw, and means for causing relative pivotal movement between said jaws.

13. In a rock-splitting machine, the combination of two jaws with opposing longitudinally correspondingly curved plain operating-faces, the elements in the trace of the plane which intersects one face horizontally extending substantially parallel with the elements in the trace of the same plane where it intersects the other face, and means for causing a relative movement between said faces whereby they change position relatively along a path which is oblique to their faces; the ratio of the components of said movement being approximately one of direct approach or recession between the faces to two of longitudinal travel along them.

14. In a rock-splitting machine, the combination of inner and outer star-shaped jaws provided respectively with internal and external faces, the projecting portions of the inner jaw extending within the corresponding portions of the outer jaw, and the diametral dimensions of the inner jaw being less than those of the corresponding dimensions of the outer jaw to leave between them an opening for the passage of material to be split, and means for causing relative pivotal movement between said jaws.

15. In a rock-splitting machine, the combination of inner and outer star-shaped jaws provided respectively with internal and external faces, the projecting portions of the inner jaw extending within the corresponding portions of the outer jaw, and the diametral dimensions of the inner jaw being less than those of the corresponding dimensions of the outer jaw to leave between them an opening for the passage of material to be split, and means for causing relative pivotal movement between said jaws, the opposing faces of the jaws converging downwardly.

16. In a rock-splitting machine, the combination of inner and outer star-shaped jaws provided respectively with internal and external faces, the projecting portions of the inner jaw extending within the corresponding portions of the outer jaw, and the diametral dimensions of the inner jaw being less than those of the corresponding dimensions of the outer jaw to leave between them an opening for the passage of material to be split, and means for causing relative pivotal movement between said jaws, the opposing faces of the jaws converging downwardly, the distance between the top portions of said faces being substantially twice the distance between the bottom portions thereof.

17. A rock-splitting machine provided with two jaws having opposing jaw-faces whose contour at successive levels extends in approximately parallel lines, and means to give a relative motion between said faces made up of two components, viz; one normal to the working faces and the other in the direction of their extent; the ratio between the normal component and the other being approximately as one to two.

18. A rock-splitting machine provided with two jaws having opposing jaw-faces whose contour at successive levels extends in approximately parallel lines, and means to give a relative motion between said faces made up of two components, viz; one normal to the working faces and the other in the direction of their extent, the ratio between the normal component and the other being approximately as one to two, and having between said faces receiving and discharging openings the widths of which bear the ratio to each other of approximately two of receiving to one of discharging.

19. In a rock-splitting machine, the combination of two jaws, mounted for relative pivotal movement, said jaws provided with correspondingly-curved plain opposing faces inclined to the direction of movement at an angle such that the movement of approach or recession of the said faces will be substantially one-half of the longitudinal movement, and the said jaw-faces on the respective jaws being spaced apart throughout and converging downwardly, their distance apart at the bottom being substantially one-half their distance apart at the top.

20. The combination of a frame comprising an outer jaw, a spider and an upright shaft, rollers on the frame, antifriction means around the shaft, a jaw carried by the rollers and having a hub surrounding the antifriction means, rollers on the last-mentioned jaw, a thrust-plate on said shaft to receive the thrust of said last-named rollers, and means for causing a relative pivotal movement between said jaws.

21. The combination of two circular jaws mounted for relative pivotal movement, one within the other and each provided with operating-faces grouped around the pivotal

point to form alternate internal and external angles, the opposed faces forming the corresponding inner and outer angles of the two jaws being correspondingly curved, and means for causing limited relative pivotal movement between said jaws.

In testimony whereof I have hereunto set my hand, at Los Angeles, California, this 11th day of November, 1905.

FRANK NEWNHAM.

In presence of—
James R. Townsend,
Tillie E. Adam.

Correction in Letters Patent No. 827,879.

It is hereby certified that in Letters Patent No. 827,879, issued August 7, 1906, upon the application of Frank Newnham, of Los Angeles, California, for an improvement in "Rock-Splitting Machines," an error appears in the printed specification requiring correction, as follows: In line 24, page 1, the word "powder" should read *power;* and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 18th day of September, A. D., 1906.

[SEAL.]

E. B. MOORE,

Acting Commissioner of Patents.