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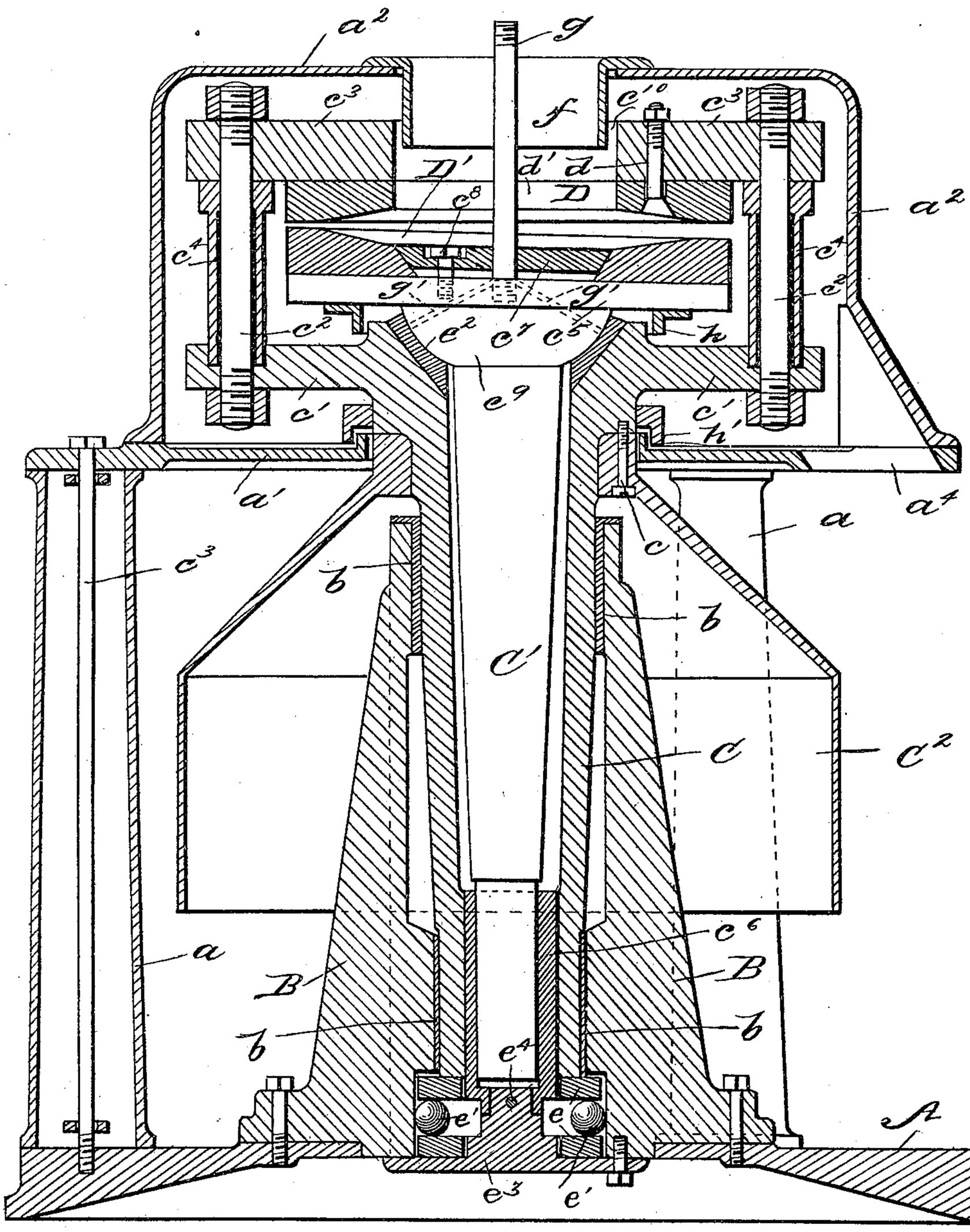
T. L. & T. J. STURTEVANT.

CRUSHING MILL.

(Application filed Oct. 25, 1898.)

(Model.)



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CRUSHING-MILL.

SPECIFICATION forming part of Letters Patent No. 641,654, dated January 16, 1900.

Application filed October 25, 1898. Serial No. 694,527. (Model.)

To all whom it may concern:

Be it known that we, THOMAS L. STURTEVANT, residing at Quincy, county of Norfolk, and THOMAS J. STURTEVANT, residing at Framingham, county of Middlesex, State of Massachusetts, citizens of the United States, have invented certain new and useful Improvements in Crushing-Mills, of which the following is a specification, reference being had therein to the accompanying drawing.

Our invention relates to an improved machine for crushing ores or other hard substances; and it comprises two rotary plates or disks, preferably of hard metal, which are mounted to rotate in the same direction and at the same speed, one plate or disk being driven positively and the other being preferably rotated by friction communicated from the positively-driven disk to the other disk through the material being pulverized between them and also by friction between contiguous portions of the operating parts of said disks. The two rotary disks are mounted upon shafts, the axes of which are inclined to or out of line with each other, so that one disk will be somewhat inclined or tilted relative to the other disk, and thus as they rotate parts of said disks will be constantly approaching while other parts are constantly receding from each other, thereby causing an opening-and-closing action of diametrically opposite parts of said disks as they rotate, which crushes the material between them in a manner analogous to the operation of crushing-jaws. The adjacent inner parts of the adjacent faces of the two disks are opened out or cut away like millstones for a considerable part of their surfaces, thereby leaving a proper space for the reception of the material to be crushed. Thus as the material which is fed through an opening or eye in the upper disk is received on the upper surface of the lower disk it will be carried outward by centrifugal force, and after having been properly crushed by the relative opening-and-closing action of the rotating disks the crushed or pulverized material will be discharged by centrifugal force in the same manner that the pulverized material is discharged from ordinary horizontally-rotating millstones.

In the accompanying drawing, which is a central vertical section of our improved crushing-mill, A denotes the base, to which is bolted the heavily-ribbed standard B, in which the vertical driving-shaft C is mounted, said shaft being provided with a driving-pulley C^2, properly attached to said shaft, as by screws *c*, said shaft being preferably hollow, as shown, so as to inclose a second shaft C′. Bearing sleeves or bushings *b* are preferably interposed between the standard B and the driving-shaft C. Mounted on the base A are columns *a*, which support the base-plate *a*′ of the casing a^2, which incloses the rotating crushing-disks and heads or plates, between which said disks are inclosed. Suitable bolts, as c^3, firmly secure the plate *a*′ and column *a* to the base A.

Formed integral with or rigidly attached to the shaft C is a head or plate *c*′, connected by bolts c^2 with the upper head or plate c^3, to which latter the upper positively-driven crushing-disk D is attached, as by bolts *d*. The bolts c^2 are preferably inclosed by sleeves c^4, the upper ends of which have threaded connections with said bolts, so that the threaded portions of said sleeves are adapted to serve as check-nuts or as adjusting-nuts to vary the position of the disk D relative to the disk D′.

D′ is the frictionally-driven crushing-disk, which is secured to the plate or head c^5, formed integral with or suitably attached to the upper end of the shaft C′, the lower end of which is inclosed by the fixed eccentric bearing c^6, interposed between said lower end and the lower part of the hollow driving-shaft C. The disk D′, as herein shown, is secured to the plate or head c^5 by the tapering clamping-disk c^7 and suitable attaching screws or bolts c^8.

The shafts C and C′ in the form of mill herein shown both extend downward from the crushing-disks with which they are connected, or, in other words, said shafts both extend from the same side of said disks.

The shaft C is provided with a step-bearing, preferably consisting of plates *e*, between

which are interposed balls e', the bearings for both of these shafts being contained within a suitable recess, serving as an oil-pocket, within the lower part of the standard B. The parts forming the step-bearing are held in place by a removable block e^3, suitably recessed for the reception of the parts of said bearing, and the eccentric sleeve c^6 is secured or locked to the upper part of said block in any suitable manner, as by a pin e^4.

The shaft C′ is provided at its upper end with an enlarged, rounded, or semispherical portion c^9, which fits against a concave bearing e^2, received in a suitable recess in the plate or head c', carried by the shaft C, thereby forming a ball-and-socket bearing, the two parts of which will always be in full contact, notwithstanding that the disk D′ is tilted or inclined relative to the disk D, due to the fact that the axis of the shaft C′ is inclined to or out of line with the axis of the shaft C.

The casing a^2 is provided at its top with a central opening, in which is preferably fitted a depending flanged tube f, the lower end of which extends downward into an opening c^{10} in the upper head or plate c^3, and the upper disk D, attached to said head or plate, is provided with a central opening or eye d'. The inner parts of the adjacent faces of the horizontally-disposed disks D and D′ are cut away to form a recess for the reception of the material, which will pass down through the feed-tube f and the eye in the upper disk D and thence outward between the crushing parts of said disks, the crushed material, after having been discharged from between the disks by centrifugal action, passing down into the lower portion of the casing a^2 and thence out at the discharge-opening a^4.

The ball-and-socket bearing at the top of the shaft C′ is preferably lubricated from an oil-pipe g, extending downward through the feed-tube f and screwed into the plate c^5 at the top of said shaft, oil-ducts g' extending from the lower end of said oil-pipe to the said ball-and-socket bearing, as indicated in the drawing. Flanged or skirted collars h and h', attached, respectively, to the head or plate c^5 and to the shaft C, are preferably provided to protect the shaft-bearings from dust or grit.

The operation of our improved crushing-mill is as follows: Power being communicated to the driving-shaft C and material being supplied to the crushing-disks through the feed-tube f, the rotation of the positively-driven disk D will cause a like rotation to be communicated to the frictionally-driven disk D′ through the material interposed between said disks and by the frictional connection between the shafts C and C′ through the ball-and-socket bearing at or near the upper ends of said shafts. As the said disks are thus rotated together they will be given an opening-and-closing action, owing to the fact that the axes of the said shafts are eccentric to or out of line with each other, thereby causing the said disks to be tilted or inclined relative to each other, and thus in their operation portions of said disks will be constantly receding from each other, while the diametrically opposite portions of the said disks will be constantly approaching each other, thus giving a nipping or crushing action on the material between said disks to crush or pulverize the said material, and when the latter is reduced to the desired degree of fineness it will be discharged from between said disks by centrifugal action as the latter rotate and open to release it. In other words, owing to the coincident rotation of the two crushing-disks on different axes one half of the surfaces of the said disks will be continuously approaching each other and the other half of the surfaces of said disks will be continuously receding from each other, thus affording two continuously-crushing and two continuously-discharging members. Owing to the fact that the eccentric bearing c^6 is fixed to the frame of the machine the point of nearest approach of the crushing-disks will remain at one side of the machine, while the point of widest separation of the said disks will remain at the other side of the machine or on the side toward the discharge-opening, and thus while the disks themselves are continuously rotating on fixed axes which are inclined or eccentric to each other and in fixed planes different parts of the said disks are continuously approaching and receding to perform the crushing action referred to. The stress due to this crushing action of the material between the disks will be mainly taken up by the rotating parts of the machine or by the rotating heads c' and c^3 and the rotating shafts C and C′ instead of being taken up by the machine-frame, as is usual in crushing-machines. This we consider an important feature of the present invention, inasmuch as it enables us to make the supporting-frame of the crusher of much lighter construction than is possible when the crushing strain is borne by the frame and not by the crushing elements themselves, as in the present case.

In order to bring the upper bearing for the driving-shaft C as close as possible to the crushing-disks, we prefer to connect the driving-pulley C^2 to said shaft by the converging or inclined web C^3, thus enabling the driving-pulley to surround the standard B, the lower part of the interior of which is utilized as an oil-pot, which contains the bearings of both of the shafts C and C′, thereby affording a strong and compact construction.

The block e^3 is removably attached to the bottom of the standard B, so as to permit of convenient access to the lower bearings for the shafts C and C′, both of which are supported by said block and are removable therewith when it may be necessary to renew them.

While we have herein shown our rotating crushing-disks revolving on different axes as being disposed or arranged to rotate horizontally, we do not wish to be understood as limit-

ing our invention to this arrangement of the crushing-disks, as these may be placed in any position from horizontal to vertical without departing from our invention. With the crushing-disks arranged vertically a side feed-chute would be employed to introduce the material to be crushed through a central opening in the outer disk. Also, although we prefer to rotate one of the crushing-disks frictionally from the positively-driven disk or its rotating mechanism, we do not wish to limit our invention to thus frictionally rotating one disk, as both may be driven positively in the same direction, if desired.

Having thus described our invention, we claim and desire to secure by Letters Patent—

1. In a crushing-machine, two rotating crushing-disks which are tilted or inclined relative to each other, combined with two rotating shafts with which said disks are connected and which shafts have their axes inclined relative to each other, and both of which shafts are on the same side of said disks.

2. In a crushing-machine, the combination with two rotating crushing-disks which are inclined or tilted relative to each other, and one of which is provided with an eye or opening for the passage of the material to be crushed, of two shafts with which said disks are rigidly connected, said shafts having their axes inclined relative to each other and both of which shafts are on the same side of said disks.

3. In a crushing-machine, the combination with two horizontally-disposed rotating crushing-disks which are inclined or tilted relative to each other and the upper of which is provided with an eye or opening for the passage of the material to be crushed, of two shafts by which said disks are carried and which shafts have their axes inclined relative to each other, said shafts both extending from the same side of said disks, and a ball-and-socket bearing between portions of the said shafts.

4. In a crushing-machine, the combination with two crushing-disks the crushing-faces of which are inclined or tilted relative to each other and one of which disks is provided with a central feed-opening, of two rotating shafts both extending from the same side of said disks and the axes of which shafts are inclined relative to each other, and two heads connected with one of said shafts and between which heads said crushing-disks are arranged, said heads serving to resist most of the strain due to crushing action.

5. In a crushing-machine, the combination with two horizontally-disposed crushing-disks the upper of which is provided with a central feed-opening, of two rotating shafts with which said disks are respectively connected so as to rotate therewith, and the axes of which shafts are inclined relative to each other, one of said shafts being hollow and the other of said shafts being inclosed by said hollow shaft, and means for positively rotating the last-named shaft.

6. In a crushing-machine, the combination with two shafts the axes of which are out of line with or inclined to each other, one of said shafts being hollow and the other of said shafts being within said hollow shaft, the said hollow shaft having at its upper end an attached head or plate, a second head or plate rigidly connected with the first-named head or plate, a horizontally-disposed crushing-disk attached to the said second head or plate and provided with a central feed-opening and a second horizontally-disposed crushing-disk carried by the inner shaft.

7. In a crushing-machine, the combination with the base A, of the standard B rigid with said base and within which is formed an oil-pot, the hollow shaft C, an antifriction step-bearing for said shaft within said oil-pot, a fixed eccentric bearing c^6 also within said oil-pot, the shaft C′ journaled in said fixed bearing and having its axis inclined relative to the axis of the said shaft C, and crushing-disks operatively connected with said shafts.

8. In a crushing-machine, the combination with the base A, of the standard B rigid with said base and within which is formed an oil-pot, the hollow shaft C, an antifriction step-bearing for said shaft within said oil-pot, a fixed eccentric bearing c^6 also within said oil-pot, the shaft C′ journaled in said fixed bearing and having its axis inclined relative to the axis of the said shaft C, and crushing-disks operatively connected with said shafts, said step-bearing for the shaft C comprising the plates *e* and a series of balls interposed between said plates.

9. In a crushing-machine, the combination with the base A, of the standard B rigid with said base and within which is formed an oil-pot, the hollow shaft C provided with the driving-pulley C^2 having the converging or inclined web C^3 for connection with said shaft, and which permits said pulley to surround the said standard B, an antifriction step-bearing for said shaft within said oil-pot, a fixed eccentric bearing c^6 also within said oil-pot, the shaft C′ journaled in said fixed eccentric bearing and having its axis inclined relative to the axis of the said shaft C, and crushing-disks operatively connected with said shafts.

10. In a crushing-machine, the combination with the rotating shafts C and C′ the axes of which are inclined relative to or out of line with each other, and relatively tilted or inclined crushing-disks carried by said shafts, the said shaft C′ being provided at its upper part with a ball-and-socket or semispherical bearing, of a central oil-tube fixed in a head or plate at the upper end of said shaft C′ and communicating, by means of suitable ducts, with the said ball-and-socket or semispherical bearing.

11. In a crushing-machine, the combination with the base A and the standard B rigid there-

with, of the shafts C and C′ journaled in said standard one within the other, crushing-disks carried by said shafts, an eccentric bearing c^6 within which the lower end of said shaft C′ is journaled, and the block e^3 to which the said eccentric bearing c^6 is fixed or locked to prevent it from turning.

12. In a crushing-machine, the combination with the base A, of the standard B rigid therewith, the shafts C and C′ having their bearings in said standard, crushing-disks operatively connected with said shafts, the block e^3 removably attached to the bottom of the said standard, a step-bearing for said shaft C supported by said block, and an eccentric bearing for said shaft C′ rigidly fixed to said block and thus also supported thereby.

13. In a crushing-machine, the combination with a crushing-disk having a driving-shaft, of a second disk the crushing-face of which is tilted or inclined relative to said first-named disk, a driving shaft or spindle on which said second disk is mounted, said shaft or spindle being inclined relative to the driving-shaft of said first-named disk, said shafts being both on the same side of said disks, means for positively rotating said first-named disk, and connections between said disks whereby the second disk may be frictionally rotated.

14. In a crushing-machine, the combination with a crushing-disk having a hollow rotating driving-shaft, of a second disk having its crushing-face tilted or inclined relative to said first-named disk, a rotary shaft for said second disk housed within said hollow shaft but inclined relative thereto, and means for positively rotating said hollow shaft.

15. In a crushing-machine, the combination with a crushing-disk, provided with a central eye or feed-opening and having a hollow rotating driving-shaft, of a second disk having its crushing-face tilted or inclined relative to said first-named disk, a rotary shaft for said second disk housed within said hollow shaft but inclined relative thereto, and means for positively rotating said hollow shaft.

16. In a crushing-machine, two crushing-disks revolving on different axes, combined with two rigidly-connected rotating heads or plates between which the said crushing-disks are mounted and by which one of them is carried, said rotating heads or plates extending beyond the circumference of the said crushing-disks, the said rotating heads or plates thus resisting most of the stress or strain incident to the crushing operation.

17. In a crushing-machine, the combination with a suitable supporting-frame, of a hollow shaft mounted therein, a crushing-disk carried by said shaft, means for rotating said hollow shaft, a second shaft or spindle rotatably mounted within said hollow shaft but having its axis eccentric thereto, a second crushing-disk carried by said second shaft, the crushing-faces of said disks being inclined relative to each other, and connections between said disks and their supporting-shafts whereby endwise thrust due to stress of grinding is taken up by the said parts and is not transmitted to the supporting-frame.

18. In a crushing-machine, the combination with two rotating crushing-disks tilted or inclined relative to each other, two rotating shafts with which said disks are rigidly connected and which shafts extend in the same direction from said disks, said shafts rotating on different axes and one of said disks being provided with an eye or opening for the passage of the material to be crushed, and said disks having their adjacent faces recessed or cut away for the reception of material between them, combined with means for rotating said disks so that portions of their proximate faces are continuously approaching while other portions are constantly receding from each other; thereby crushing the material and then discharging the crushed material by centrifugal action.

19. In a crushing-machine, the combination with two shafts the axes of which are out of line with or inclined to each other, one of said shafts being hollow and the other of said shafts being within said hollow shaft, the said hollow shaft having at one end a head or plate, a second head or plate connected with the first-named head or plate, a crushing-disk attached to the said second head or plate and provided with a central feed-opening, and a second crushing-disk carried by the inner shaft.

In testimony whereof we affix our signatures in the presence of two witnesses.

THOMAS L. STURTEVANT.
THOMAS J. STURTEVANT.

Witnesses:
L. P. STURTEVANT,
LLOYD MAKEPEACE.