To all whom it may concern:

Be it known that I, GEORGE H. FRASER, a citizen of the United States, residing in the borough of Brooklyn, county of Kings, city and State of New York, have invented certain new and useful Improvements in Machines for Grinding and Crushing, being a resiling of my application Serial No. 502,071, filed Nov. 20, 1913, of which the following is a specification.

This invention relates to machinery for crushing, grinding or pulverizing materials, and aims to provide certain improvements therein.

The invention relates more particularly to rock crushers of the type having a plurality of crushing rolls within an annular die in which the crushing is effected between the peripheral of the rolls and the inner face of the die. Examples of this type of crusher are well known in which the die revolves and is held in position yieldingly by the rolls which support it, or rigidly by a shaft supported in bearings and connected to the die by a head or spider, the rolls being pressed outwardly by springs to resist a crushing pressure from the inner face of the die, and being movable radially thereof to yield to adapt themselves to the work.

When the die is supported by the rolls, means are generally provided for driving one of the rolls, which drives the die and the other rolls by traction. When the die is the driven member, all of the rolls are driven by traction.

My present invention aims to provide an improved crusher or pulverizer especially applicable to the type in which the die is the driven member, but includes various features of improvement which can be employed in other types of crushers.

To this end in carrying out my present invention in its preferred form, I provide an improved arrangement of die and rolls, improved means for carrying the rolls, improved means for guiding them, improved means for transmitting all or part of the crushing thrust from one roll to another, improved means for holding the die, improved means for controlling the size of material discharged from the crusher, and various details of improvement in the construction and arrangement of the several parts of the machine, all of which will be more fully set forth with reference to the accompanying drawings, in which—

Fig. 1 is a side elevation, partly in vertical axial mid-section, of a crusher constructed according to the preferred form of my invention;

Fig. 2 is a plan view thereof partly in horizontal axial mid-section;

Fig. 3 is a front elevation thereof partly in section through the axis of the crusher springs, the door being open to show the interior; and

Fig. 4 is a rear elevation thereof partly in section through the axis of the rear bearing.

Referring to the drawings, let A indicate a frame, B the ring or die, C the rolls, D their shafts or axles, E the roll carriers or bearings, S the crushing springs, and D the adjusting screw.

In the type of machine shown the ring revolves at sufficient speed to cause the material to be crushed to be held on the concave inner crushing face of the ring by centrifugal force, and the rolls are rotatively held and are pressed against this face by the crushing springs to crush the material between them. The crushed material is forced over the edges of the ring and falls through the outlet a in the base. When the ring is of the driven type here shown, it is carried by a cup-shaped head or spider G mounted on a shaft H carried from supports V on the base A, and driven in any suitable manner, as by a pulley J connected by a friction clutch K to drive a counter-shaft L which drives the shaft H through spur gears M.

Power applied to revolve the ring causes the rolls to revolve by traction, and the movable roll carriers permit the rolls to move inwardly to adapt themselves to the crushing operation. Material is fed on to the descending side of the ring in front of one of the lower rolls through a feed hopper N and chute O, and revolves with the ring until crushed sufficiently to flow over its sides. The ring and rolls are enclosed in a crushing chamber in the casing P.
to yield to the shocks of use, and is maintained in parallelism with the axes of the rolls. This cushioning of the die reduces the liability to crystallization and fracture of the parts, and avoids rigidity in resisting shocks, and is preferably accomplished by pivotally mounting the shaft $H$ in a swinging frame $Q$ pivotally mounted on a movable axis $R$, which in turn is mounted in a swinging frame $T$ fulcrumed to the base, the parts being so constructed and connected that the bearing yoke or frame $Q$ can swing upwardly or laterally, but will be caused to move in parallelism with the axes of the rolls by the action of the guiding frame $T$. The yoke $Q$ has widely separated bearings $U$ for the shaft $H$, one near the head $G$ and the other near the rear end of the shaft, and an intermediate connection $b$ rigidly joining these bearings. From the bearings the yoke has horizontally extending arms $a$ and $e$ which are fulcrumed to the upwardly projecting arms $f$ of the yoke $T$, so that the yoke $Q$ can oscillate vertically. The yoke $T$ has a tubular barrel or body $g$ rigidly connecting its arms $f$ and fulcrumed by a shaft $h$ to the standards or supports $V$ carried on the frame or base $A$, so that its arms can swing horizontally to permit horizontal movement of the shaft $H$. The yoke $Q$ is preferably constructed with a pocket or casing $i$ enclosing the gears $M$ and forming part of its rear arm $e$, by which it is connected to the pivotal shaft $R$ at one side and to the pulley shaft $L$ at the other side of the bearings. The arm $e$ is preferably duplicated on the yoke, so that at one side it may serve as one bearing for the shaft $L$ and on the other side for pivotally connecting the yoke to the rocker $T$, the construction being such that the rocker may be at either side and the countershaft at the other side as desired.

In effect, the yoke $Q$ is a rigid casing carrying bearings for the ring shaft, the countershaft and rocker connection, and movably to permit the movement in any direction at right angles to the axis of the die, so that the latter may move but will be preserved in parallelism with the rolls.

In the type of machine in which the die is not supported by the rolls, I prefer to support the die by this yoke yieldingly in suspension against the action of cushioning springs or other suitable provisions. As shown, this is accomplished by poising the yoke on a plurality of springs carried by the supports $V$ and reacting against the bearing ends of the yoke $Q$ in various directions, preferably in opposition to the directions of action of the several rolls. Preferably each bearing is vertically supported yieldingly by a spring $S$ seated in a pocket in the support, reacting upwardly against the bearing to carry its weight, which spring is yieldingly resisted by a reverse spring $X$ beneath the yoke reacting downwardly on a bolt $j$ engaging the yoke and serving, through the medium of an adjustable nut $k$, to draw the two springs together until the vertical position desired for the shaft $H$ has been attained, whereupon the yoke is held yieldingly in this position against rising or falling except to momentarily cushion a shock.

Horizontal positioning of the yoke is effected preferably by laterally acting springs $Y$ carried by the supports $V$ at each side of the yoke bearing, and reacting against the latter laterally and preferably in opposition to the action of the corresponding crushing roll to resist horizontal swing of the yoke, the springs $Y$ being confined by bolts $l$ and adjustable nuts $m$ to limit their expansion beyond the point at which the yoke is held in the desired lateral position.

The springs are duplicated at each end of the yoke so that the latter is poised and cushioned in its normal position, but may move or vibrate sufficiently to avoid breakage incident to shocks and crushing, and may be adjusted vertically to vary the position of the ring relatively to the rolls, or to throw more or less of the weight of the ring on to the rolls when it is desired that these shall partially support the ring. This vertical adjustability of the ring may be increased to any range desired, and utilized as a crushing force or to take up wear.

According to another feature of improvement the crushing rolls are movably mounted, preferably to swing on axes inwardly of the inner crushing face of the ring and parallel with the axis of the rolls when the rolls are mounted in substantially the same horizontal plane on an axis or axes intermediate of their axes of rotation, so that their carriers incline outwardly from a fixed point of support as seen in Fig. 3, and a third roll is movably mounted above them, and thrust provisions intermediate of the rolls are provided which react against the two horizontal rolls with a pressure that is countervailing against each, and the reaction of the third roll is transmitted to the other rolls, so that depression of the upper roll tends to separate the lower rolls, and this tendency is resisted by the inner face of the ring, more or less of the weight of which is carried by the upper roll, transmitted through the lower rolls, and resisted by the intermediate point of pivotal support of the latter. The divergent swinging carriers of the lower rolls, and the divergently acting intermediate thrust members between these and the upper roll, serve to resist a crushing pressure from the inner face of the ring when the ring is supported independently of the rolls, or to resist this and the weight of the ring when the ring is so adjusted or supported that its weight is carried by the
rolls, either partially as in the construction shown, or wholly as when the cushioning springs are adjusted out of engagement with it.

This may be accomplished in various ways, the two supporting rolls being suitably mounted with their axes in approximately the same horizontal plane, and so that one or both shall be held outwardly to resist a crushing pressure from the inner face of the ring and transmit it to the other roll, and both shall be capable of wholly or partially supporting the ring when this is vertically movable, and of positioning it horizontally when it is horizontally movable.

I prefer to pivotally or swingingly mount two rolls so that their axes are in approximately the same horizontal place below the normal axis of the ring, and their carriers are movable to swing them approximately horizontally radially of the ring, and to provide a yielding thrust member intermediate of the carriers for movably holding the rolls apart and toward the inner face of the ring, and to provide a third roll movably mounted and engaging the inner face of the ring near the upper part thereof, and held thereagainst by a thrust member acting expansively against the two lower rolls to hold them outwardly under the weight of the ring. As shown, all of the rolls C are rotatably mounted on swinging carriers E pivotally carried by a support Z which is as shown in Fig. 3, removably fixed or mounted on the frame A, by bolts I so that on removing one of these bolts the support can be moved pivotally on the other bolt and has tubular or horizontal projections n having pivotal provisions for shafts or pins o which project through the interior of the ring and pivotally support the carriers E on each side of the rolls. One pin o is preferably used for the lower carriers of both the lower rolls, and disposed centrally intermediate thereof so that these carriers incline upwardly and outwardly from this pin and diverge approximately equally, whereby the weight of the rolls and carriers is partially available as a crushing element, and the carriers tend to resist unequal horizontal displacement, as their angularity would cause a roll to move upwardly as well as inwardly, and thus tend to lift the top roll and raise the ring in case of horizontal movement of the latter. This arrangement of carriers aids in positioning the parts in operation, and gives the maximum utilization of their weight and action for crushing purposes.

The carriers of the upper roll are preferably pivotally horizontally radially of the roll. The carriers at each side of the rolls are preferably freely pivotally and removably mounted so that one on either side may be detached for removing a roll, and as shown each roll is rotatably mounted on its carriers preferably by being slipped over an axle or shaft D which is fixed or pinned to the carriers to connect them together through the roll, so that they will move uniformly, which axle carries a bearing lining p partially surrounding it and held against rotation by a key or pin q on the lining engaging a seat or keyway r on the axle to hold the lining at the pressure side thereof. The roll has a tubular hub or center fitting over the lining p between the carriers E, by which it is held in place axially, and leakage of lubricant at the ends of this hub is prevented by spring-pressed cup-shaped washers s embracing the end of the hub, revolving therewith, and pressed against the adjacent face of the carrier by springs t or otherwise to make a closure at this point to keep lubricant in and dust out. Each axle D is preferably provided with a longitudinal oil duct u communicating through the key or open projection q on the lining with the interior of the roll for supplying lubricant thereto from a cup v outside of the casing, and with an outlet w for escape of lubricant at the end of the keyway beneath the lining, these being arranged so that the lubricant forced in passes through the lining to the inner bore of the roll, flows outwardly to the ends of this bore, and then returns through the keyway, which is wider than the projection q, and escapes through the outlet w.

Any suitable means for holding the rolls outwardly may be employed, but I prefer to provide means at each side of the rolls so that they may move in parallelism and to provide for equalizing pressure at each side, so that their action may be uniform at each side of the die. Preferably these holding means are intermediate of the carriers and act outwardly against them, and are expansive, adjustable, and movable both axially and radially of the die, and are connected together through the die to position and control them, and are collapsible to adjust them or remove the rolls from the die.

As shown, these means comprise a crushing spring S opposite and pivotally connected to each carrier, extending approximately radially inwardly and pivotally connected to a movable member intermediate of and receiving the reaction of the several springs for transmitting the pressure of each to the other or others. Preferably each carrier is formed with a semi-spherical socket z receiving the semi-spherical head of a spring carrier y which is loosely pivoted to it, and the spring S is disposed between this carrier and an adjustable spring nut z screwed on a bolt a', which has a semi-spherical head pivotally mounted in a semi-spherical socket in the movable carrier b' and loosely connected thereto, the parts being constructed.
with abutting faces or shoulders on the principle of a knuckle joint which engage to prevent them from swinging past the head center in one direction, but permit their relative movement in the other direction for adjustment or collapsing. The spring S acts expansively, and its seat and nut are connected together by the bolt α which telescopically engages the seat and has a nut α' which prevents separation of the parts. The nut s can be adjusted to increase spring pressure or take up wear. The carriers b' are connected by a thrust bar d on which they are preferably reversely threaded, so that they can be screwed together to adjust or collapse the thrust members. To prevent turning, the carriers b' preferably have forked projections e' straddling the lower extension n of the support Z, and having clearance enough to permit all necessary movements of the spring carriers. The thrust bar or screw d projects through a clearance hole d' in the cover so that it can adapt itself axially of the die to equalize the different springs, and this hole is closed by a dust guard f' sliding on the screw and pressed outwardly by a spring g' surrounding the latter, the cover h' being provided with this hole for the screw, and with a hole i' opposite each roll axle.

The cover h' is preferably hinged to the support Z, and this support is preferably an annular member on the periphery of which the sheet metal cover J of the casing P is clamped. The support Z has a tubular flange l' against which the cover h' closes, and through which the rolls and carriers may be removed or access to the interior may be had. The support Z is preferably fixed to the base A by its bolts I (see Fig. 3) either of which can be removed so that it can be swung outwardly on the other as a pivot bolt. The internal parts from the ring and it is slidingly mounted thereon so that by removing both bolts I it can be slid outwardly for this purpose, on freeing one or both of its pivotal bolts I.

The feed hopper N is mounted on the support Z, and the chute O passes through the front wall of the support to the interior of the ring to direct feed thereon.

My invention provides for mounting check pieces at each side of an exteriorly supported or positively driven ring to limit size or mesh of the material discharged therefrom. This is preferably accomplished by supporting these check pieces through the interior of the ring and mounting them preferably relatively yielding and collectively movably therein, so that they can yield to free material caught between them, and can move to adapt themselves to the movements of the ring. I prefer to employ an annular check piece A' at each side of the ring, and to support these by a slidingly mounted bar B' carried by the support Z projecting through the ring and carrying each check piece. As shown, three bars B' are bars which traverse ears in the check pieces which are spaced apart on the bars in any suitable manner, as by a piece of pipe k', and yieldingly held thereagainst by springs m' so that the pieces can yield or can move to adapt themselves to conditions. In this manner the size of material escaping from the ring can be controlled, and the check pieces and their supports will be clear of the spokes of the revolving head G, and for some work the necessity for using an outside screen with a crusher will be avoided.

In operation, when the ring is driven the rolls will revolve therewith by traction. Material flowing from the hopper and chute on to the descending inner face of the ring will be crushed between this and the periphery of the roll, and forced off the sides of the ring on to the check pieces, between which and the ring it will escape to the discharge if fine enough to pass between them. If too coarse to escape, the material will return to the ring for further crushing. The ring will yield on its cushion carriers to adapt itself to the crushing shocks, and the rolls will yield against the crushing springs, which will resist their motion through reacting toward the other rolls. The weight of the ring will be more or less thrown on to the rolls, so that these wholly or partially support it by adjusting its supporting springs as desired, and in such case this weight will be supported by the rolls, and the tendency of the ring to descend resisted by the divergently acting projections intermediate of the rolls, which will transmit the inward pressure of each to the other with a force that's countervailing in two or more directions.

Radial adjustment of the springs S to take up wear or increase pressure will be made with the spring nuts s, or axial adjustment to vary pressure or to collapse the thrust members will be made with the screw d, which when these members are adjusted to any angularity inwardly of the dead center will act as a floating compression member intermediate of them, movable axially to equalize their action at each side of the rolls, and when the parts are adjusted outwardly until the springs are at angles to the axis, the knuckle joint connections will prevent axial displacement of the thrust members and ensure their maintaining proper working positions for the maximum of thrust effect for which they are adjusted.

It will be seen that the rolls are movable passively as a group, and individually, and that their expansive forces are equalized intermediate of their carriers and confined within the ring, so that all forces incident to the operation of these parts may be utili-
lized for crushing the material to be treated, and none will be lost by transmission to fixed parts.

While I have described and shown my improvements as applied to a machine in which the ring is the driven member, it will be understood that the invention is not limited to this type of machine, nor to the particular details of construction, arrangement and combination of parts set forth and shown as constituting its preferred form, since my improvements can be used in whole or in part in connection with such types of machines or according to such modifications or adaptations as circumstances or the judgment of those skilled in the art may dictate, without departing from the spirit of the invention.

The support Z has rearward bifurcated inclined feet C extending beyond the center of gravity of the weight it carries and meeting similar forwardly extending feet D on the front support V, which together serve as the upper part of the outlet chute and to which the casing is fastened. The bolts I traverse the feet C opposite the center of the die and are so disposed that the support can be swung on either bolt to open the mill.

What I claim is:

1. In combination, an annular externally driven crushing die having an internal crushing face, a movable and rotatable crushing roll within and eccentric to said die and having a peripheral crushing face reciprocal to the inner face of said die, means for revolving said die, and a support on which said roll is movably and rotatably mounted comprising an outer support portion mounted exteriorly of said die and having a portion past one side of said die affording an aperture at the side of said roll through which the latter can be passed and having projecting inwardly from and sustained by said outer portion a rigid inner roll supporting portion within and extending through said die and movably and rotatably sustaining said roll within said die opposite said recess.

2. In combination, an annular crushing die having an internal crushing face, a movable and rotatable crushing roll within and eccentric to said die and having a crushing face reciprocal to that of the latter, means for revolving one of said parts, a movable carrier for said roll comprising separable parts at each side thereof, and an axle carried by said parts and on which said roll is rotatably mounted, and a frame for said parts comprising a fixed supporting portion inwardly of said die and intermediate of the separable parts of said carrier and on which the latter is movably mounted, and having a recess opposite said roll through which the latter can be removed.

3. In combination, an annular crushing die having an internal crushing face, a movable and rotatable crushing roll within and eccentric to said die and having a crushing face reciprocal to that of the latter, means for revolving one of said parts, a swinging carrier on which said roll is rotatably mounted, and a frame for said parts comprising a supporting portion disposed at one side of said die and affording a recess at the opposite side of said die and having a fixed pivotal provision extending through said die and past said roll supporting and pivotally engaging said carrier at each side thereof.

4. In combination, an annular externally driven crushing die having an internal crushing face, a rotatable crushing roll within and eccentric to said die and having a peripheral crushing face reciprocal to the inner face of said die, means for revolving said die, and a non-rotative support on which said roll is rotatably mounted having an outer portion mounted exteriorly of said die and extending past one side of said die and having a stationary portion extending through said die and having a stationary roll sustaining portion at the other side of said die from which said roll is rotatably sustained at that side of said die.

5. In combination, an annular crushing die having an internal crushing face, two or more movable and rotatable crushing rolls within and eccentric to said die and each having a crushing face reciprocal to that of the latter, means for revolving one of said parts, movable carriers on which said rolls are rotatably mounted respectively, thrust members on each side of said rolls intermediate of said carriers for holding said rolls outwardly away from one another to resist a crushing pressure from the inner face of said die, and a movable part passing through said die and intermediate of said thrust members for adjusting them.

6. In combination, an annular externally driven crushing die having an internal crushing face, a movable and rotatable crushing roll within and eccentric to said die and having a peripheral crushing face reciprocal to the inner face of said die, means around and revolving past said roll for revolving said die, non-rotative movable means on which said roll is rotatably mounted, a support on which said non-rotative means are movably mounted exteriorly of said die and having a portion extending past one side thereof, and pressing means disposed at the opposite side of said die and opposite and acting against said non-rotative means to press said roll outwardly toward the inner face of said die to resist a crushing pressure therefrom and sustained through said die from said supporting means at the other side thereof.
7. In combination, an annular externally driven crushing die having an internal crushing face, a movable and rotatable crushing roll within and eccentric of said die and having a peripheral crushing face reciprocal to the inner face of said die, means around and revolving past said roll for revolving said die, movable non-rotative carriers on which said roll is rotatably mounted, a support on which said non-rotative means are movably mounted exteriorly of said die and having a portion extending past one side thereof, and pressing means disposed inwardly of said non-rotative means at the other side of said die and opposite and acting against said non-rotative means for pressing said roll outwardly toward the inner face of said die to resist a crushing pressure therefrom and connected to said supporting means through said die.

8. In combination, an annular externally driven crushing die having an internal crushing face, two rotatable crushing rolls movable toward and from each other within and eccentric of said die and each having a peripheral crushing face reciprocal to the inner face of said die, and having a portion extending past one side of said die, and pressing means disposed at the other side of said die opposite and acting on said non-rotative means respectively to press said rolls outwardly away from one another to resist a crushing pressure from the inner face of said die and sustained through the interior of said die from said supporting means at the other side of said die.

9. In combination, an annular externally driven crushing die having an internal crushing face, two rotatable crushing rolls movable toward and from each other within and eccentric of said die and each having a peripheral crushing face reciprocal to the inner face of said die, means around and revolving past said rolls for revolving said die, movable non-rotative carriers at each side of said die and on which said rolls are rotatably mounted respectively, a non-rotative support for said carriers on which said carriers are movably mounted respectively exteriorly of said die and having a portion extending past one side of said die, and pressing means disposed at each side of said die opposite and acting against said carriers at the opposite sides of said die respectively to press said rolls outwardly away from one another to resist a crushing pressure from the inner face of said die and sustained through the interior of said die from said supporting means at one side of said die.

10. In combination, an annular externally driven crushing die having an internal crushing face, three rotatable crushing rolls movable toward and from each other within and eccentric of said die and each having a peripheral crushing face reciprocal to the inner face of said die, means around and revolving past said rolls for revolving said die, movable non-rotative carriers on which said rolls are rotatably mounted respectively, a non-rotative support for said carriers on which said carriers are movably mounted respectively exteriorly of said die and having a portion extending past one side of said die, and pressing means disposed at the other side of said die opposite and acting against said non-rotative carriers respectively to press said rolls outwardly away from one another to resist a crushing pressure from the inner face of said die and sustained through the interior of said die from said supporting means at the other side of said die.

11. In combination, an annular externally driven crushing die having an internal crushing face, a rotatable crushing roll within and eccentric of said die and having a peripheral crushing face reciprocal to the inner face of said die, a support for said roll mounted exteriorly of said die and having a portion extending past one side of said die and on which said roll is rotatably mounted, a revolving head rotatably mounted at the other side of said die and connected to said die for revolving it, and a non-rotary cheek piece opposite and affording an outlet at and mounted at the side of said die remote from said head.

12. In combination, an annular externally driven crushing die having an internal crushing face, a rotatable crushing roll within and eccentric of said die and having a peripheral crushing face reciprocal to the inner face of said die, a support for said roll mounted exteriorly of said die and having a portion extending past one side of said die and on which said roll is rotatably mounted, a revolving head rotatably mounted at the other side of said die and connected to said die for revolving it, and non-rotary cheek pieces opposite and affording outlets from each side of said die supported exteriorly of said die.

13. In combination, an externally driven crushing die having an internal crushing face, a rotatable crushing roll within and eccentric of said die and having a peripheral crushing face reciprocal to the inner face of said die, a support for said roll mounted exteriorly of said die and on which said roll is rotatably mounted, a revolving head rotatably mounted at the other side of said die and connected to said die for revolving it, and non-rotative axially adjustable cheek.
pieces opposite and affording outlets at the sides of said die connected together through the interior of said die and supported exteriorly of said die.

14. In combination, an annular crushing die revolving in an approximately vertical plane and having an internal crushing face, a movable and rotatable crushing roll within and eccentric of the upper part of said die and having a peripheral crushing face reciprocal to the inner face of said die, means for revolving one of said parts, non-rotative movable means on which said roll is rotatably mounted, pressing radial means below and radially of the axis of said roll and opposite and acting radially against said non-rotative means to press said roll outwardly toward the inner face of said die to resist a crushing pressure therefrom, and transversely movable means sustaining said pressing means and movable transversely of the direction of stress of the latter.

15. In combination, an annular crushing die revolving in an approximately vertical plane and having an internal crushing face, a movable and rotatable crushing roll within and eccentric of the upper part of said die and having a peripheral crushing face reciprocal to the inner face of said die, means for revolving one of said parts, non-rotative movable means on which said roll is rotatably mounted, pressing radial means below and radially of the axis of said roll and opposite and acting radially against said non-rotative means to press said roll outwardly toward the inner face of said die to resist a crushing pressure therefrom, and movable sustaining means for said spring.

16. In combination, an annular crushing die revolving in an approximately vertical plane and having an internal crushing face, a movable and rotatable crushing roll within and eccentric of the upper part of said die and having a peripheral crushing face reciprocal to the inner face of said die, means for revolving one of said parts, non-rotative movable means on which said roll is rotatably mounted, pressing radial means below and radially of the axis of said roll and opposite and acting radially against said non-rotative means to press said roll outwardly toward the inner face of said die to resist a crushing pressure therefrom, and movable sustaining means for said adjustable means.

17. In combination, an annular crushing die revolving in an approximately vertical plane and having an internal crushing face, a movable and rotatable crushing roll within and eccentric of the upper part of said die and having a peripheral crushing face reciprocal to the inner face of said die, means for revolving one of said parts, non-rotative movable means on which said rolls are rotatably mounted respectively, movable holding means disposed inwardly of the axes of said rolls respectively and opposite and acting radially outwardly toward said non-rotative means respectively to hold said rolls outwardly away from one another to resist a crushing pressure from the inner face of said die, and movable sustaining means intermediate of and sustained by and sustaining two of said holding means.

18. In combination, an annular crushing die revolving in an approximately vertical plane and having an internal crushing face, a movable and rotatable crushing roll within and eccentric of the upper part of said die and having a peripheral crushing face reciprocal to the inner face of said die, means for revolving one of said parts, non-rotative movable means on which said roll is rotatably mounted, a pressing spring disposed below and radially of the axis of said roll and acting upwardly against said non-rotative means to hold said roll toward the inner face of said die to resist a crushing pressure therefrom, and movable sustaining means movable transversely of and sustaining said spring.

19. In combination, an annular crushing die revolving in an approximately vertical plane and having an internal crushing face, a movable and rotatable crushing roll within and eccentric of the upper part of said die and having a peripheral crushing face reciprocal to the inner face of said die, means for revolving one of said parts, non-rotative movable means on which said roll is rotatably mounted, adjustable holding means below and adjustable radially outwardly relatively to the axis of said roll and opposite and acting against said non-rotative means to hold said roll outwardly toward the inner face of said die to resist a crushing pressure therefrom, and movable sustaining means for said adjustable means.

20. In combination, an annular crushing die revolving in an approximately vertical plane and having an internal crushing face, two movable and rotatable crushing rolls within and eccentric of said die and each having a peripheral crushing face reciprocal to the inner face of said die, means for revolving one of said parts, non-rotative movable means on which said rolls are rotatably mounted respectively, movable holding means disposed inwardly of the axes of said rolls respectively and opposite and acting radially outwardly toward said non-rotative means respectively to hold said rolls outwardly away from one another to resist a crushing pressure from the inner face of said die, and movable sustaining means intermediate of and sustained by and sustaining two of said holding means.

21. In combination, an annular crushing die revolving in an approximately vertical plane and having an internal crushing face,
two movable and rotatable crushing rolls within and eccentric of said die and each having a peripheral crushing face reciprocal to the inner face of said die, means for revolving one of said parts, non-rotative movable means on which said rolls are rotatably mounted respectively, movable holding means disposed inwardly of the axes of said rolls respectively and opposite and acting radially outwardly toward said non-rotative means respectively to hold said rolls outwardly away from one another to resist a crushing pressure from the inner face of said die, and yieldingly mounted sustaining means intermediate of and yieldingly sustained by and sustaining two of said holding means and transmitting the stress of one to another.

22. In combination, an annular crushing die revolving in an approximately vertical plane and having an internal crushing face, three rotatable crushing rolls one above the others within and eccentric of said die and each having a peripheral crushing face reciprocal to the inner face of said die, means for revolving one of said parts, non-rotative movable means on which said lower rolls are rotatably mounted respectively, radial movable holding means inwardly of and above the axes of said lower rolls and acting downwardly and outwardly against said movable non-rotative means respectively to hold said lower rolls outwardly away from one another to resist a crushing pressure from the inner face of said die, and movable sustaining means inwardly of and receiving the stress of two of said holding means and transmitting the inward stress of one to another.

23. In combination, a revolving annular crushing die having an internal crushing face, three rotatable crushing rolls movable toward and from each other within and eccentric of said die and each having a peripheral crushing face reciprocal to the inner face of said die, means for revolving one of said parts, non-rotative movable means on which said rolls are rotatably mounted respectively, outwardly acting holding means disposed inwardly of the axes of said rolls and opposite and acting outwardly against said non-rotative means respectively for holding said rolls outwardly toward the inner face of said die to resist a crushing pressure therefrom, movable transversely of their direction of stress of retire of said rolls, and transversely movable sustaining means for said holding means respectively movable transversely thereof for moving them, and means for moving said transversely movable means transversely of such direction.

24. In combination, an annular crushing die having an internal crushing face, a movable and rotatable crushing roll within and eccentric of said die and having a peripheral crushing face reciprocal to the inner face of said die, means for revolving one of said parts, movable means on which said roll is rotatably mounted, swinging holding means acting on said movable means for holding said roll outwardly toward the inner face of said die to resist a crushing pressure therefrom, movable adjusting means swingingly engaging said holding means and movable transversely of the stress thereof, and inter-engaging faces on said holding means and one of said parts affording abutting stops for limiting swinging motion of said holding means.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

GEORGE H. FRASER.

Witnesses:
CHAS. E. DONNELLY,
ANTONIO BUCONO.