Jan. 16, 1934. G. H. FRASER 1,943,306

PULVERIZER AND SEPARATOR

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Fig. 1.

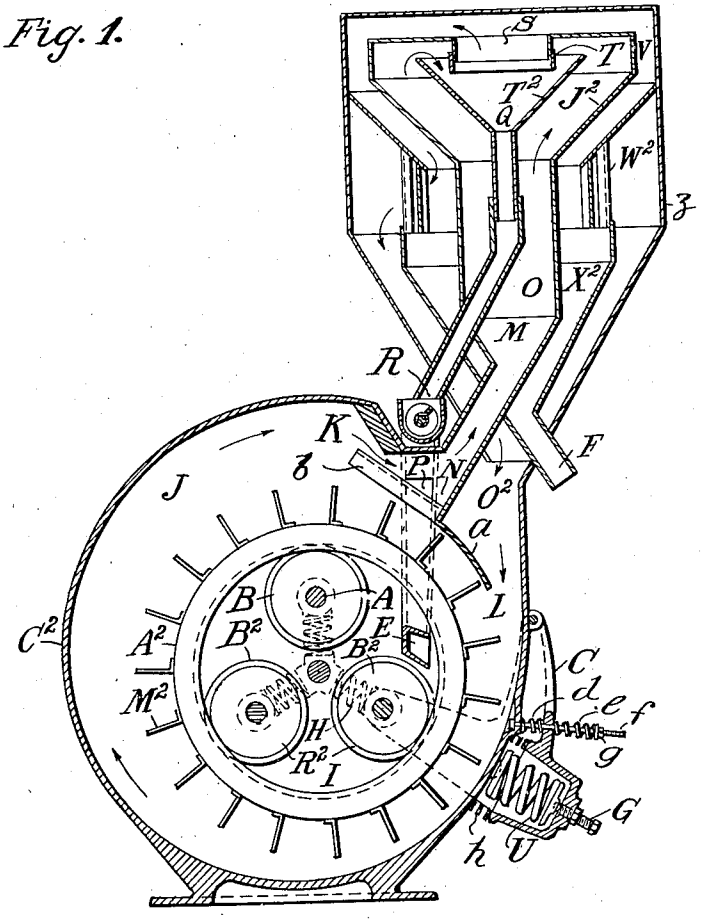
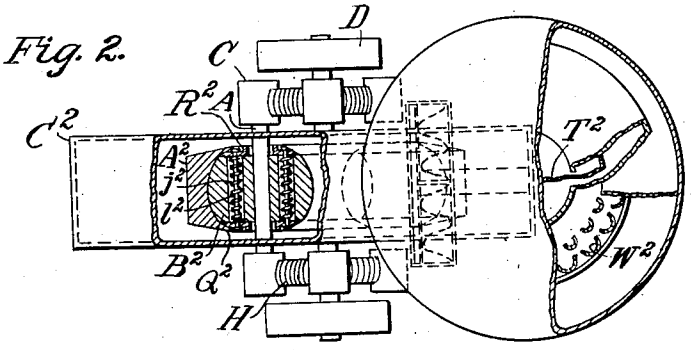



Fig. 2.




INVENTOR

George Holt Fraser

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# UNITED STATES PATENT OFFICE

1,943,306

## PULVERIZER AND SEPARATOR

George Holt Fraser, Brooklyn, N. Y.

Application November 30, 1931
Serial No. 577,918

20 Claims. (Cl. 83—9)

This application is a continuation in part of my original application, Serial No. 26,033, filed April 27, 1925, patented December 1, 1931, No. 1,834,095.

This invention relates to pulverizers and air separators for pulverizing materials and separating and collecting fine material, and aims to provide improvements in such for use especially with mills of the ring and roll type in which the ring has an annular crushing face disposed about a substantially horizontal axis.

In such devices as heretofore constructed the die has been rotatively mounted within and concentric of an enclosing casing constituting with it part of an endless current passage extending through the interior of the die and to the suction side of an outside blower for exhausting air and fine material from inwardly of the die, and blowing the air and fine material floating therein to an outside dust collector, the exhaust from which is returned to such casing and sucked into the interior of the die, for sucking fine material through the die and returning coarse material inwardly of the die, which constructions by making the interior of the die a part of the endless circuit through which the air is circulated have affected efficiency by subjecting the material to an outblowing current during its pulverization within the die.

My present invention aims to improve pulverizing machines by avoiding current molestation of the material within a die during pulverization, and to this end I preferably provide a current passage around and externally of the die instead of through it, and discharge the pulverized material from the die into such external passage, and circulate the outblowing current outwardly of the outer periphery of and around circumferentially of the die to minimize entrance of current within the latter, and I preferably provide a circular or spiral casing spaced around the die and having a peripheral tangential discharge outlet outwardly of the outer periphery of the die, to peripherally discharge dust laden current outwardly of and tangentially from the die and through such outlet, and I preferably provide a current inlet outwardly of and tangentially of the outer periphery of the die, for inletting cleaned current tangentially around instead of axially through the die, and I preferably provide a rotary blower around the outer periphery of die for centrifugally circulating such current around the latter; and I preferably mount the die and the blower within and eccentric of such circular or spiral casing and intermediate said tangential outlet and tangential inlet and adjacent the latter, and I preferably provide a partition wall adjacent the blower and intermediate said outlet and said inlet for defining the path of such current from such blower to such outlet and from such inlet to such blower.

In my said original application I have shown a ring disposed in a horizontal plane and affording in under, up through, and down around, such ring, an endless current passage, a blower for circulating a separating current in the form of a vortex ring through such passage, for floating fine material up through the ring, and a filter across such passage for intercepting fine material and conducting out of such current fine material floating in said passage, as distinguished from that part of my invention herein claimed, which aims to provide an endless current passage disposed around a horizontal axis, and externally of instead of through the die, and outwardly of and circumferentially around the periphery of and having effluent and influent passages separated by the die, the die affording an inner wall for such current passage, and I provide separating means in such successive to the effluent passage and precedent to the influent passage, with blower means revolving around the outer periphery of the die for circulating such current around its periphery to separate and float fine material from externally of the die through said passage and separating means and returning cleaned current externally of the die, to the end that the separating current shall not molest the material during pulverization by traversing the die axially as in my said original application.

To this end in carrying out the preferred form of the part of my invention to which this application pertains I preferably provide a casing enclosing a blower chamber having a curved periphery disposed around a horizontal axis and having peripheral effluent and influent openings connected by a current passage and affording a closed endless circuit, and I preferably provide a rotary die rotatable around a horizontal axis and within and in spaced relation to the casing and intermediate the effluent and influent openings thereof for affording an inner wall for such passage, and I preferably provide fan blades around the outer periphery of and revolving with the die for drawing air into and through the influent passage and circulating it in the casing and blowing it through the effluent passage to cause it to circulate through the connecting passage and past the filter means and return cleaned air to the influent passage, and I prefer-

ably dispose the connecting passage above the die and provide it with a grit well and a gravity chamber connected to the supply for returning grit and coarse particles by gravity to the die, and with a volumetrically variable fine particle settling chamber for returning by gravity fine particles to the supply, and with adjustable valve means for varying the speed of the current, and with a dust filter for intercepting dust floating in the returning current, and with a gravity dust discharge communicating through and extended externally without the connecting passage, for continuously circulating around the die fine material discharged radially of it, for blowing such material into the connecting passage, classifying it, returning oversize for further grinding, and removing the fine dust.

According to another feature of my said invention as claimed in this application I preferably provide a rotary crushing roll having a peripheral crushing face within and eccentric of the annular crushing face of the die, and provide for tractionally revolving one of said parts by the other by providing said parts at each side of the crushing faces with axially resistant co-acting tractional drive faces wedgingly engaging to axially press said faces into tractional engagement to avoid slippage of said parts during their rotation, and I preferably provide three crushing rolls with crushing faces in the form of a segment of a sphere so that they may rock slightly, and mount them on inclinable shafts so that they may assume a slight relative angularity to afford a slight friction or attrition effect in crushing the material between their crushing faces and that of the ring, and I preferably mount such shafts in inclinable bearings which may be rocked to compensate for any relative angularity between the shafts; and I preferably rock such bearings in swinging bearing members which are out-pressed by adjustable pressure springs and radially positioned by positioning springs in the plane of such adjustable springs and in the plane and radially outward of the die, and I provide various other features of improvement all of which will be hereinafter more fully set forth with reference to the accompanying drawing in which

Fig. 1 is a fragmentary vertical longitudinal section of a pulverizing and separating machine embodying the preferred form of the part of my invention to which this application applies;

Fig. 2 is a fragmentary plan view thereof partly broken out to show the ring and one of the lower rolls in axial section, and partly broken away to show the connecting passage and the filter therein in horizontal section;

Referring to Figs. 1 and 2 I will now describe that part of my said invention claimed herein.

Let $A^2$ indicate the ring, B the upper roll, $B^2$ the lower rolls, $C^2$ the casing, D the drive, E the feed supply, and F the fine outlet of a pulverizing and separating machine. These parts may be of any usual or suitable construction affording a crushing chamber and crushing elements therein, which can co-operate to pulverize coarse infed material and separate and withdraw pulverulent material. Either or both of the crushing elements may revolve about a substantially horizontal axis, and centrifugal force or other means may be used to generate crushing force necessary to pulverize the material between the reciprocal co-acting crushing faces of these elements. As shown the ring $A^2$ is a rotary annular die mounted in the casing $C^2$ and having an inner concave crushing face in the form of a segment of a sphere revolving in a substantial vertical plane, and the rolls B and $B^2$ are radially movable and rotate on substantially horizontal axes and have peripheral crushing faces in the form of a segment of a sphere, within and eccentric of the ring and acting against its crushing face to crush material between these faces, the top roll being driven by the pulley D and tractionally driving the ring, which in turn tractionally drives the lower rolls, the material entering through the supply chute E falling on the inner face of the ring with which it revolves and against which it is crushed by the rolls, and the crushed material flowing out past the sides of the ring and into the crushing chamber around it. Any number of rolls may be used, three being shown, and the ring may be supported and radially positioned in any suitable manner, preferably by mounting it on the rolls and as shown by mounting the rolls on shafts A rotatably carried in radially movable swinging bearing frames C out-pressed by adjustable pressure springs U and adjusting screws G and by radial intermediate springs H for pressing the rolls against the ring with a yielding crushing pressure each pressure spring U being usually without the casing $C^2$ and radially reactant against it and toward the inner side of the bearing frame C and in the plane of the ring, and the pressure springs H when used being preferably at each side of the rolls and intermediate of and radially reactant outwardly toward their shafts.

According to one feature of the part of my invention to which this application pertains I preferably radially position each bearing frame C relatively to the casing $C^2$ independently of or additionally to its adjustable pressure spring U, preferably by providing between the bearing frame C and casing $C^2$ and around the pressure spring U a positioning spring *h*, preferably concentric of the spring U and preferably around it and radially of and in the plane of the ring $A^2$, and reactant radially of the latter toward the casing $C^2$ and the frame C for yieldingly resisting inward movement of the frame radially toward the casing independently of the adjustment of the pressure spring U.

According to another feature of the part of my invention to which this application pertains I preferably yieldingly poise, confine and position, the bearing frame C relatively to the casing $C^2$ independently of the pressure spring U, preferably by providing a compression spring *d* between the bearing and the casing and radially reactant against these to radially resist inward movement of the bearing toward the casing, and by providing a compression spring *e* outwardly of the bearing frame C and radially reactant inwardly toward such frame and outwardly toward a radially adjustable nut *g* adjustable on a tension screw *f* traversing the springs *d* and *e* and connected to the outer casing $C^2$, for resisting outward stress of the spring *e*, and for adjusting its inward stress toward the frame C, for radially positioning and elastically poising the latter relatively to the casing $C^2$. The springs *d* and *e* are preferably at one side of the pressure spring U and extended radially of the casing $C^2$ and are preferably disposed in the plane of the ring $A^2$.

According to one feature of the part of my said invention to which this application pertains, the periphery of the outer casing $C^2$ is preferably semi-circular and semi-spiral and disposed

around a substantially horizontal axis and encloses an inner blower chamber J comprising a curved passage encircling the crushing elements and having an upper effluent K and a lower influent L, which are both preferably tangential of the periphery of the casing and are preferably connected by an intermediate connecting passage M, the blower chamber being disposed around and preferably eccentric of and spaced relatively to the die, the outer periphery of which is preferably eccentric of and spaced inwardly from the periphery of the casing $C^2$ and affords an inner wall for the curved passage and is disposed between the effluent K and the influent L to cause the separating current to circulate through the connecting passage M before returning to the influent L, and rotary blower blades $M^2$, preferably eccentric of the blower chamber J, and revoluble about a horizontal axis and around and preferably mounted on the periphery of and revolving with the die are mounted between the die and the casing and project across the curved passage between them for drawing the returning air in through the influent L and whirling it in the blower chamber J toward the effluent K to cause the air to float fine material from around the periphery of the ring through the effluent and the connecting passage M, without molesting the air within die or the material being crushed therein.

According to another feature of my invention to which this application pertains I preferably provide the connecting passage M with a grit well N for receiving large particles, and with a gravity chamber O for precipitating medium particles into the well N, and with a grit refeeding passage P for returning such particles to the supply E for repulverization.

According to another feature of my invention to which this application pertains I preferably provide the connecting passage M with a volumetrically variable settling chamber Q in which fine particles may settle, and with a refeeding chute R for returning such particles to the supply E for repulverization, preferably by providing a vertically adjustable damper wall $T^2$ in the connecting passage M around its upper outlet F, by vertically varying which the volumetric area of the settling chamber Q may be varied to vary the speed of the current flowing through it to vary the size of the fine particles settling therein.

According to another feature of my said invention to which this application pertains I preferably provide the connecting passage with an adjustable valve T through which current through the connecting passage may flow, for varying such current for varying the fineness of separation.

According to another feature of my said invention to which this application pertains I preferably provide across the connecting passage dust intercepting means, as the successive staggered spaced troughs $W^2$ having hollow faces opposed to the direction of flow of the dust laden current for forming current voids in which dust floating in such current may precipitate and descend out of the zone of the current, and I provide a dust receiver $X^2$ below such troughs for receiving such dust and conducting it through the cleaned returning current and discharging it exteriorly thereof to the dust outlet.

When used in a mill of the type in which the ring is disposed about a horizontal axis and is revolved by or revolves around rolls carried by movable non-rotative members the part of my invention to which this application pertains, provides for using slightly concave and convex peripheral crushing faces the ring $A^2$ and the rolls B and $B^2$ and axially resistant tractional engaging wedge shaped or tapering attrition co-operating tractional drive faces $Q^2$ and $R^2$ at each side of the crushing faces of the ring and rolls, and for making the tapering faces of one of these parts axially resistant to the axial compressive faces of the other of these parts, so that they may wedge together to effect the desired tractional engagement for preventing slippage between them when one rotates the other. This may be provided for in any suitable manner and the male and female tractional faces may be provided on these parts as desired, but I prefer to make the male tapering faces on each side of the rolls yieldingly act and axially expansible as by springs $j^2$ and bolts $l^2$, within adjustably determinable limits relatively to the reciprocal faces on the ring.

Where the upper driving roll and the two lower rolls are used with a revolving ring, according to that part of my invention to which this application pertains I preferably mount the driving roll on an axis parallel with the ring and mount the lower rolls on reversely inclined axes, each having a slight angularity or wind relatively to the axis of the upper roll, as indicated in dotted lines for the inclined ends of the lower shafts in Fig. 1, so that one of the lower rolls tends to drive the ring slightly to one side and the other roll to a slight extent to the other side, thus balancing their side driving action, and affording a slight friction or attrition effect between their grinding faces and that of the ring, this I preferably accomplish by mounting the lower rolls on lower shafts which are slightly out of parallel, as indicated in dotted lines in Fig. 1.

Preferably according to the part of my said invention to which this application pertains when applied to a traction die mill the revolving fan blades $M^2$ are mounted eccentric of the casing, preferably by being mounted on the periphery of the revolving die $A^2$ so that the inner periphery of the casing $C^2$ affords a space similar to the spiral interior of a blower casing, to facilitate progress and discharge of the air current, which is discharged upwardly at a point of greater area, and floats the dust with it into the settling chamber, where the grit is precipitated back into the crushing chamber and finer dust is carried over the adjustable partition $T^2$ into the selecting chamber Q, where oversize is precipitated and the fineness desired escapes with the air through the central outlet S into the outer separating chamber V, where it passes through the filter $W^2$ to intercept the dust and send it to the dust outlet F while permitting the cleaned air to return to the down side of the blower chamber near the point where the path of the fan blades is narrowest. In such case the grit is returned by gravity to the crushing elements.

In operation material to be crushed will be entered through the supply E, with the grit and oversize returned from the passage M, and these will be pulverized between the ring and rolls and discharged at the sides of the ring. The blower blades will draw clean air through the inlet L and blow dust laden air through the outlet K, and the connecting passage will grade and return the floating particles and float fine dust into the separating chamber V, from which the air will flow through the filter $W^2$ to the return passage $O^2$ and descend to the inlet L. Con-

tinuous circulation of the air through this endless passage will permit separation of the dust as introduced and simultaneously return the coarse particles for repulverization.

It will be seen that my invention provides improvements which can be variously and advantageously availed of, and it will be understood that the invention is not limited to the particular details of construction, arrangement, or combination of parts, set forth as constituting its preferred form, since my improvements can be used in whole or in part, and according to any suitable desired modification, as the judgment of those skilled in the art may dictate, without departing from the spirit of the invention.

The connecting passage may be any suitable passage between the tangential blast passage K and the tangential return passage L, and the wall $J^2$ between the blast passage and the return passage may be of any suitable shape to permit the current flowing from the blast passage to the return passage to be cleaned of dust before reaching the return passage. The wall *a* which separates the blast and the current passages is preferably concentric with and adjacent the outer peripheries of the fan blades, and the wall *b* under the blast passage is preferably an inclined bottom wall or shelf for the grit well N to cause grit falling on it to flow laterally to the grit opening P communicating with the supply chute E, and the valve T can be any adjustable valve or damper for varying the current space past the wall $J^2$, and the current passage and the intermediate passage for receiving the tangential effluent current and returning the tangential influent current may be as simple and direct as desired, but I prefer to form it between spaced concentric walls $J^2$ and $X^2$ within a cylindrical overhead enclosing casing *z*.

What I claim is:

1. In combination, a casing enclosing a crushing chamber, a rotatable die within said chamber having an inner annular crushing face disposed around a substantial horizontal axis, a movable and rotatable roll within and eccentric of said die and having a peripheral crushing face acting toward said face to crush material between said faces, rotary means for rotating one of said parts, supply means for supplying material to be crushed to said faces, a movable bearing movably mounted on said casing and on which said roll is rotatably mounted, an adjustable spring for pressing said roll toward said die with an adjustable crushing pressure, and an additional spring around said adjustable spring and between said casing and said bearing member, without and reactant inwardly toward said casing and inwardly of and reactant outwardly toward said bearing member, for positioning the latter relatively to said casing additionally to said adjustable spring.

2. In combination, a casing enclosing a crushing chamber, a rotatable die within said chamber having an inner annular crushing face disposed around a substantially horizontal axis, a movable and rotatable roll within and eccentric of said die and having a peripheral crushing face acting toward said face to crush material between said faces, rotary means for rotating one of said parts, supply means for supplying material to be crushed to said faces, a movable bearing movably mounted on said casing and on which said roll is rotatably mounted, an adjustable spring for pressing said roll toward said die with an adjustable crushing pressure, and a spring adjacent and independent said adjustable spring and intermediate said casing and said bearing member, radially of and without said casing and reactant inwardly toward said casing, and inwardly of and reactant outwardly toward said bearing member, for positioning the latter and limiting its movement toward said casing.

3. In combination, a casing enclosing a crushing chamber, a rotatable die within said chamber and having an inner annular crushing face disposed around a substantially horizontal axis, a movable and rotatable roll within and eccentric of said die and having a peripheral crushing face acting toward said face to crush material between said faces, rotary means for rotating one of said parts, supplying means for supplying material to be crushed to said faces, a movable bearing movably mounted on said casing and on which said roll is rotatably mounted, an adjustable spring for pressing said roll toward said die with an adjustable crushing pressure, and a compression spring adjacent said adjustable spring and outwardly of said bearing member, radially of and outwardly of said casing, and reactant inwardly toward said bearing member for resisting outward movement of the latter and positioning said bearing member relatively of said casing independently of said adjustment spring.

4. In combination, a casing enclosing a crushing chamber, a rotatable crushing die within said chamber and having an inner annular crushing face disposed about a substantially horizontal axis, a movable and rotatable crushing roll within and eccentric of said die and having a peripheral crushing face acting toward said face to crush material between said faces, rotary means for rotating one of said rotary parts, means for supplying material to be crushed to said faces, a swinging bearing member rotatably carrying said roll and swingably mounted on said casing, an adjustable pressure spring, for adjustably pressing said roll toward said ring to generate a crushing pressure between said faces, a compression spring between said casing and said swinging member, at one side of said swinging member and additional to said pressure spring, reactant toward said swinging member for yieldingly holding the latter in one direction, and a second additional compression spring at another side of said swinging member and reactant toward said swinging member for yieldingly holding the latter toward an opposite direction, for yieldingly positioning the latter relatively to said casing independently of said adjustable spring.

5. In combination, a casing enclosing a substantially circular chamber, disposed around a horizontal axis and having circumferentially spaced tangential peripheral discharge and inlet openings, an annular crushing die having an outer periphery within and in spaced relation to said casing, and having an annular inner crushing face disposed about a substantially horizontal axis, for crushing material within said die and discharging fine material into said chamber, a rotatable crushing roll within and eccentric of said die and having a peripheral crushing face acting toward said face to crush material between said faces, means for supplying material to be crushed to said faces, rotary means for rotating said roll, and revoluble fan blades within and eccentric of said chamber and around the periphery of said die and revoluble around said die and in said chamber for centrifugally cir-

culating air therein, around the outer periphery of said die and from said tangential inlet through said tangential outlet, for floating such fine material around the outer periphery of said die and for discharging such fine material outwardly of the outer periphery of said die and circumferentially of said chamber through said tangential discharge opening.

6. In combination, a casing enclosing a crushing chamber, a rotatable crushing die within said chamber and having an annular inner crushing face disposed around a substantially horizontal axis, a rotatable crushing roll within and eccentric of said die and having a peripheral crushing face acting toward said face to crush material between said faces, supply means for supplying material to be crushed to said faces, rotary means for rotating one of said parts, and tractional drive means for tractionally driving one of said rotary parts from the other of said rotary parts comprising outwardly beveled male tractional faces on the one and reciprocally beveled female traction faces on the other, said female faces in the axial plane of said male faces and wedgingly engaged by the latter, for tractionally drivingly gripping said faces to prevent peripheral slippage between said die and said roll, said male traction faces and said female traction faces being the ones axially yieldable relatively to the others, for yieldably tractionally engaging said faces.

7. In combination, a casing enclosing a crushing chamber, a rotatable crushing die within said chamber and having an inner annular crushing face disposed about a substantially horizontal axis and having an axially flared tractional face at each side of said crushing face, a rotatable crushing roll within and eccentric of said die and having a peripheral crushing face opposite said crushing face for crushing material between said faces and having a reciprocally flared tractional face at each side of said peripheral face, for tractionally engaging said flared faces for tractionally driving said die roll the one from the other, drive means for rotating one of said rotary parts, supply means for supplying material to be crushed to said crushing faces, said tractional faces of said roll being axially adjustable relatively to said tractional faces of said die for adjustably spacing said tractional faces.

8. In combination, a casing enclosing a crushing chamber, a rotary crushing die in said chamber having an inner annular crushing face disposed about a substantially horizontal axis, a rotatable crushing roll within and eccentric of said die and having a peripheral crushing face toward said face for crushing material between said faces, rotary means for rotating one of said parts, supply means for supplying material to be crushed to said faces, and guide means for relatively axially guiding said die and roll comprising axially flared side guide faces on said die, and similarly flared detachable side wedge guide faces detachably carried by said roll, said guide faces disposed at the sides of said crushing faces and in the axially plane of one another, and axially engageable for limiting realtive axial movement of said die and roll.

9. In combination, a casing enclosing a crushing chamber, a rotatable crushing die within said chamber and having an annular inner crushing face disposed about a substantially horizontal axis, a rotatable crushing roll within and eccentric of said die and having a peripheral crushing face toward said face for crushing material between said faces, drive means for rotating one of said rotary parts, supply means for supplying materials to be crushed to said faces, said die having at each side of said inner crushing face a beveled traction face, and said roll naving at each side of said peripheral face a separate similarly beveled traction face, said traction faces axially interengageable for limiting relative axial movement of said die and roll, and a connection between said separate traction faces at the sides of said roll extended axially of said roll, for axially positioning said separate faces relatively to said roll.

10. In combination, a casing enclosing a crushing chamber, a rotary crushing die in said chamber having an inner annular crushing face disposed around a substantially horizontal axis, a rotary crushing roll within and eccentric of said die and having a peripheral crushing face toward said face for crushing material between said faces, means for rotating one of said rotary parts, means for supplying material to be crushed to said faces, and means for axially positioning said die and roll comprising removable annular check rings removably bolted to said roll and having beveled edges in the axial plane of and at the sides of said die, for permitting relative axial movement of said roll and die and for checking excessive relative axial movement thereof.

11. In combination, a casing enclosing a crushing chamber, a rotary and axially movable crushing die in said chamber having an inner annular crushing face disposed about a substantially horizontal axis, a rotary upper crushing roll within and eccentric of said die and having a peripheral crushing face toward said face for crushing material between said faces, and on which face of said roll said die is axially movably mounted, rotary means for revolving one of said rotary parts, a rotary lower crushing roll within and eccentric of said die and having a peripheral crushing face toward said annular face for crushing material between said faces, shaft means on which said lower roll is rotatably mounted, bearing means at the side lower of said roll and in which said shaft means are rotatably mounted, for radially and axially positioning said lower roll, and means for checking axial movement of said die axially of said lower roll comprising beveled rotary removable annular check faces at each side of said peripheral crushing face of said lower roll, and in the axial plane of and engageable with said die, for limiting axial movement of said die relatively to said rolls.

12. In combination, a casing enclosing a substantially circular crushing chamber disposed around a substantially horizontal axis and having peripheral spaced tangential outlet and inlet openings, a crushing die within and having an annular outer periphery spaced from said casing and having an annular inner crushing face disposed around a substantially horizontal axis, for crushing material and for discharging fine material from said die into said chamber, a rotatable crushing roll within and eccentric of said die and having a peripheral crushing face toward said face for crushing material between said faces, rotary means for revolving said roll, supply means for supplying material to be crushed to said faces, and rotary fan blades within and eccentric of said chamber, intermediate said outlet and said inlet openings and around the outer periphery of said die, revoluble in the space between the outer periphery of said die and said

casing for causing a separating current to flow circumferentially around said die from said inlet opening to said outlet opening for floating fine material circumferentially of said chamber around and outwardly of the outer periphery of said die and for discharging such fine material peripherally tangentially from said chamber through said tangential outlet opening.

13. In combination, a casing enclosing a substantially spiral crushing chamber disposed around a substantially horizontal axis and having a tangential current outlet and a tangential current inlet, a crushing die within said chamber and having an outer periphery within and in spaced relation to said casing and having an inner annular crushing face disposed about a substantially horizontal axis for receiving material to be crushed, and for discharging crushed material from said die into said chamber, a rotatable crushing roll within and eccentric of said die and having a peripheral crushing face toward said face for crushing material between said faces, supply means for supplying material to be crushed to said faces, rotary means for revolving said roll, and rotary fan blades within and eccentric of said chamber and around said die revolving in the space between said die and said casing for causing a fluid current to circulate within and peripherally around said chamber and without and around the outer periphery of said die from said inlet to said outlet to float fine material outwardly of and around the outer periphery of said die and circumferentially of said spiral chamber between said inlet and said outlet, and for discharging such fine material tangentially from said spiral chamber outwardly of the outer periphery of said die.

14. In combination, a casing enclosing a substantially circular crushing chamber disposed about a substantially horizontal axis and having a peripheral tangential discharge outlet and a current inlet, a rotary crushing die within said chamber having an outer periphery within and in spaced relation to said casing, and having an inner crushing face disposed around a substantially horizontal axis, for receiving and crushing material and for discharging fine material from said die into said chamber, a rotatable crushing roll within and eccentric of said die and having a peripheral crushing face toward said face for crushing material between said faces, a supply inlet for supplying material to be crushed to said faces, rotary means for rotating said die, and rotary fan blades within and eccentric of said chamber and around the outer periphery of said die, revoluble in the space between said casing and said die, for causing a fluid current to enter said chamber through said inlet and to flow circumferentially around said chamber outwardly of the outer periphery of said die, for floating fine material circumferentially around said chamber outwardly of the outer periphery of said die and for discharging such fine material tangentially of said chamber and outwardly of the outer periphery of said die through said tangential discharge outlet.

15. In combination, a casing enclosing a substantially circular crushing chamber disposed around a substantially horizontal axis and having a peripheral tangential discharge outlet and a peripheral tangential current inlet, a rotary crushing die within said chamber and having an outer periphery within and in spaced relation to said casing, and having an inner crushing face disposed around a substantially horizontal axis for receiving material to be crushed and for discharging fine material from said die into said chamber, a rotary crushing roll within and eccentric of said die and having a peripheral crushing face toward said face for crushing material between said faces, supply means in communication with said faces for supplying material to be crushed to said faces, rotary means for rotating said die, and rotary fan blades within and eccentric of said chamber, and adjacent said inlet and around the outer periphery of said die, revoluble in the space between the outer periphery of said die and said casing for causing a separating current to enter said chamber through said inlet and flow around and circumferentially of said chamber outwardly of the outer periphery of said die and through said outlet for floating fine material circumferentially around said chamber and outwardly of the outer periphery of said die, and for discharging such fine material through said tangential outlet tangentially from said chamber and outwardly of the outer periphery of said die.

16. In combination, a casing enclosing a substantially spiral crushing chamber disposed about a substantially horizontal axis and having a peripheral tangential current inlet and a peripheral tangential discharge outlet, a rotary crushing die within said chamber and having an outer periphery within and in spaced relation to said casing and having an annular inner crushing face disposed around a substantially horizontal axis for receiving material to be crushed and discharging crushed material around said die and into said chamber, a rotary crushing roll within and eccentric of said die and having a peripheral crushing face toward said face for crushing material between said faces, rotary means in operative relation to said roll, for rotating said roll, and rotary fan blades within and eccentric of said chamber and adjacent said inlet and around the outer periphery of said die, revoluble around the substantially horizontal axis and in the space between said casing and the outer periphery of said die, for causing a fluid current to enter said chamber through said inlet and flow circumferentially around said chamber and outwardly of the outer periphery of said die for floating crushed material circumferentially around said chamber outwardly of the outer periphery of said die, and for discharging such crushed material through said tangential discharge outlet tangentially of said chamber and outwardly of the outer periphery of said die.

17. In combination, a casing having a substantially circular peripheral wall enclosing a substantially circular crushing chamber disposed about a substantially horizontal axis and having a tangential peripheral discharge outlet, a crushing die within and spaced from said casing, having an outer periphery within said chamber and spaced inwardly from said peripheral wall, and having an inner annular crushing face disposed around a substantially horizontal axis, for receiving material to be crushed and for discharging crushed material at the side of said face and outwardly into said chamber, a rotatable crushing roll within and eccentric of said die and having a peripheral crushing face toward said face, for crushing material between said faces, supply means in communication with said faces, for supplying material to be crushed by said faces, rotary means in operative relation to said roll, for rotating said roll, and rotary fan blades within said chamber and around the outer periphery of said

die, rotatable around a substantially horizontal axis and in the space between the inner periphery of said casing, and the outer periphery of said die, for causing a fluid current to circulate around the inner periphery of said casing and outwardly of the outer periphery of said die for floating crushed material circumferentially around the inner periphery of said casing, and outwardly of the outer periphery of said die, and for tangentially discharging such fine material through said tangential discharge outlet peripherally tangentially of said casing and outwardly of the outer periphery of said die.

18. In combination, a casing having a substantially circular peripheral wall disposed around a substantially horizontal axis and enclosing a substantially circular crushing chamber having a peripheral tangential discharge outlet, a rotatable crushing die within and in spaced relation to said casing, having an outer periphery within and spaced inwardly of the curved periphery of said casing and having an inner annular crushing face disposed around a substantially horizontal axis, for receiving material to be crushed and for discharging material outwardly past said die and into said chamber, a rotatable crushing roll within and eccentric of said die and having a peripheral crushing face toward said face for crushing material between said faces, rotary means in operative relation to one of said rotary parts, for rotating said rotary parts, supply means in communication with said faces, for supplying material to be crushed by said faces, and rotary fan blades within said chamber and around the outer periphery of said die, rotatable around a substantially horizontal axis and in the space between the periphery of said casing and the outer periphery of said die, for causing a fluid current to circulate within and peripherally of said casing and around and outwardly of the outer periphery of said die, for floating crushed material within said chamber peripherally around the curved wall of said casing and outwardly of the outer periphery of said die and for tangentially discharging such fine material tangentially of said chamber and peripherally of said curved wall and outwardly of the outer periphery of said die through said tangential outlet.

19. In combination, a casing having a curved peripheral outer wall disposed about a substantially horizontal axis and enclosing a substantially circular crushing chamber having a current inlet and having a peripheral tangential discharge outlet, a crushing die within and in spaced relation from said casing, having an outer periphery within said chamber and spaced inwardly from said curved periphery, and having an inner annular crushing face disposed around a substantially horizontal axis, for receiving material to be crushed and for discharging crushed material outwardly across said die and into said chamber, a rotatable crushing roll within and eccentric of said die and having a peripheral crushing face toward said face, for crushing material between said faces, rotary means in operative relation to said roll, for rotating said roll, supply means in communication with said faces, for supplying material to be crushed by said faces, and rotary fan blades within said chamber and between said inlet and said outlet and around the outer periphery of said die, rotatable around a substantially horizontal axis and through the space between the curved periphery of said casing and the outer periphery of said die, for causing a fluid current to enter said chamber through said inlet and to circulate peripherally around said chamber within the curved periphery of said casing and around the outer periphery of said die and to outflow peripherally of said casing and tangentially of said chamber and outwardly of the outer periphery of said die through said tangential outlet, for floating crushed material peripherally around the curved wall of said casing and outwardly of the outer periphery of said die and for centrifugally tangentially discharging such fine material and such current outwardly of the outer periphery of said die and tangentially of said chamber through said tangential outlet.

20. In combination, a casing having a curved outer wall disposed about a substantially horizontal axis and enclosing a substantially circular crushing chamber having a tangential discharge outlet, a rotatable crushing die, rotatable about a substantially horizontal axis and having an outer periphery within said chamber and spaced inwardly from said curved wall, and having an inner annular crushing face for receiving material to be crushed and for discharging crushed material outwardly past said die and into said chamber, a rotatable crushing roll within and eccentric of said die and having a peripheral crushing face toward said face for crushing material between said faces, rotary means in operative relation to said die, for rotating said die, supply means in communication with said faces, for supplying material to be crushed by said faces, and rotary fan blades within said chamber, inwardly of said curved wall and outwardly of the outer periphery of said die, and concentric of and rotatable around said die, and through the space between said curved wall and the outer periphery of said die, for causing a fluid current to flow peripherally around said chamber, circumferentially of said curved wall and outwardly of the outer periphery of said die, for floating such crushed material circumferentially of said chamber and peripherally of said curved outer periphery of said die, and for discharging such material tangentially of said chamber and outwardly of the outer periphery of said die through said tangential discharge outlet.

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