Jan. 11, 1938. J. J. MORCH 2,105,003

ORE CRUSHING MACHINE

Filed April 11, 1934 3 Sheets-Sheet 1

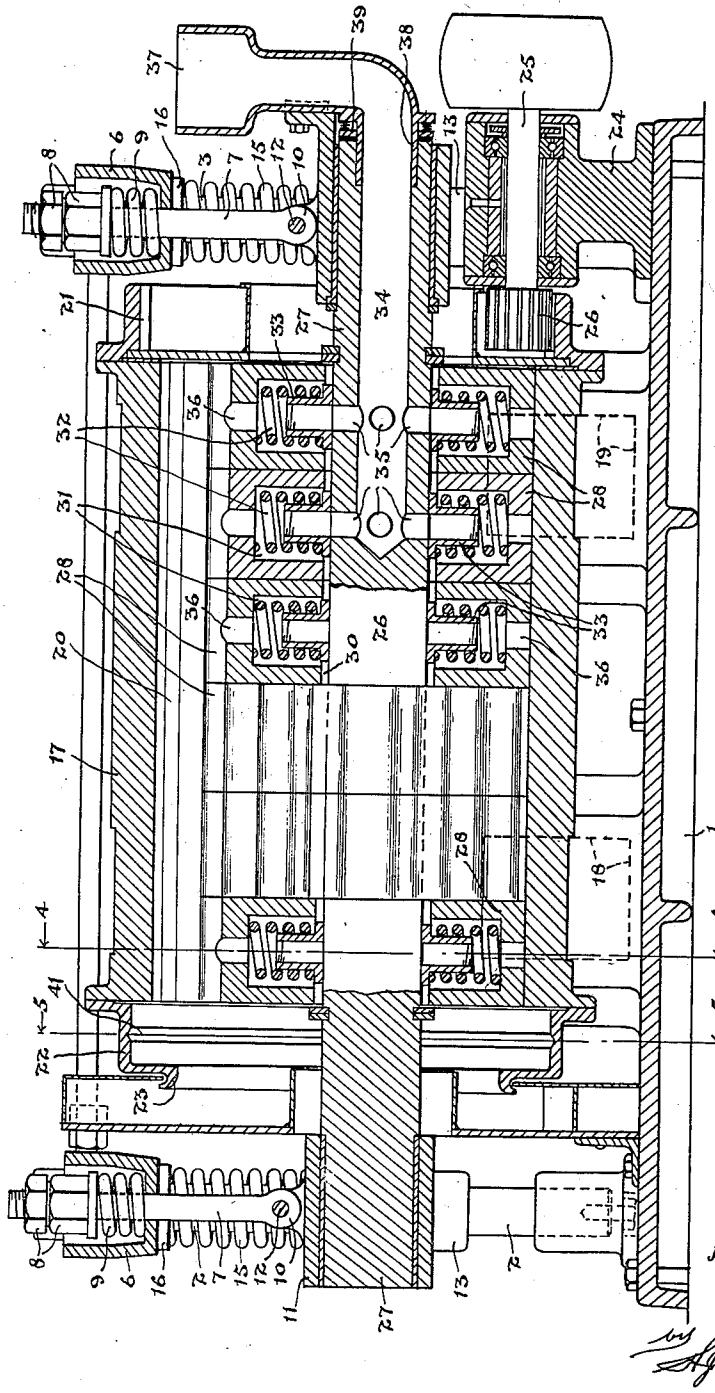


Fig. 1.

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ORE CRUSHING MACHINE

Filed April 11, 1934 3 Sheets-Sheet 2

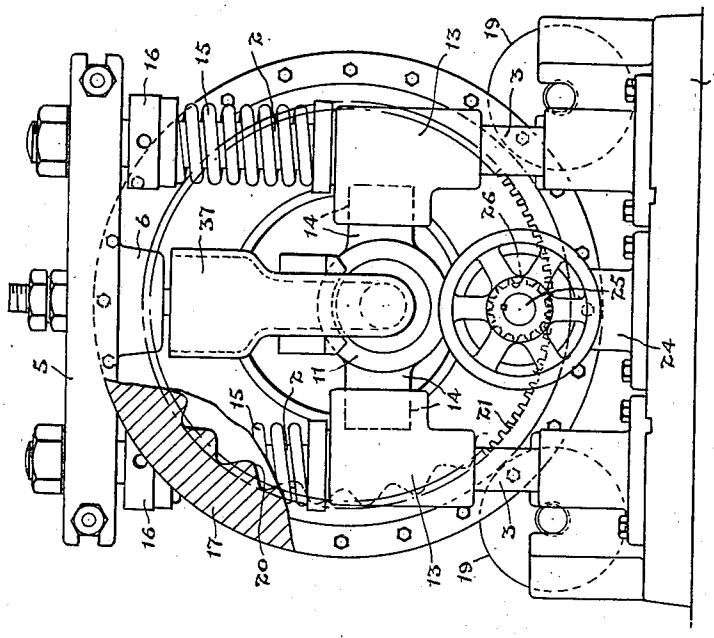


Fig. 2.

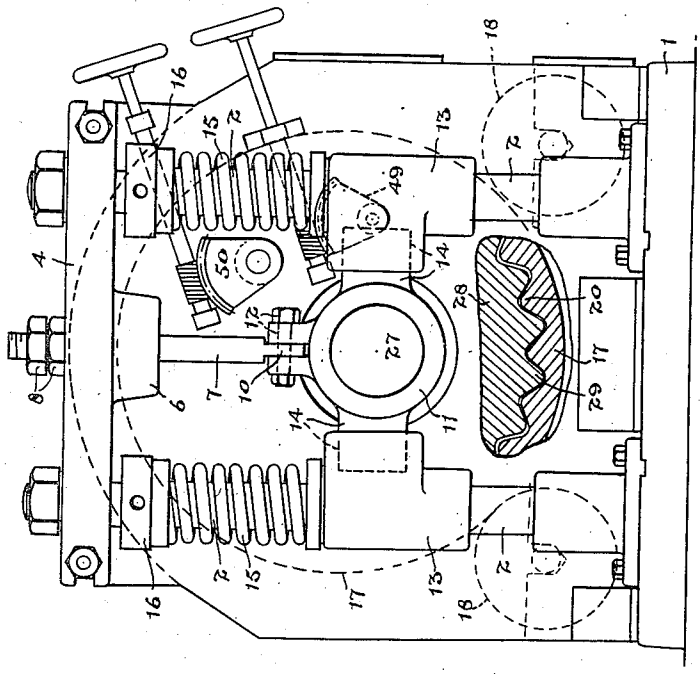


Fig. 3.

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ORE CRUSHING MACHINE

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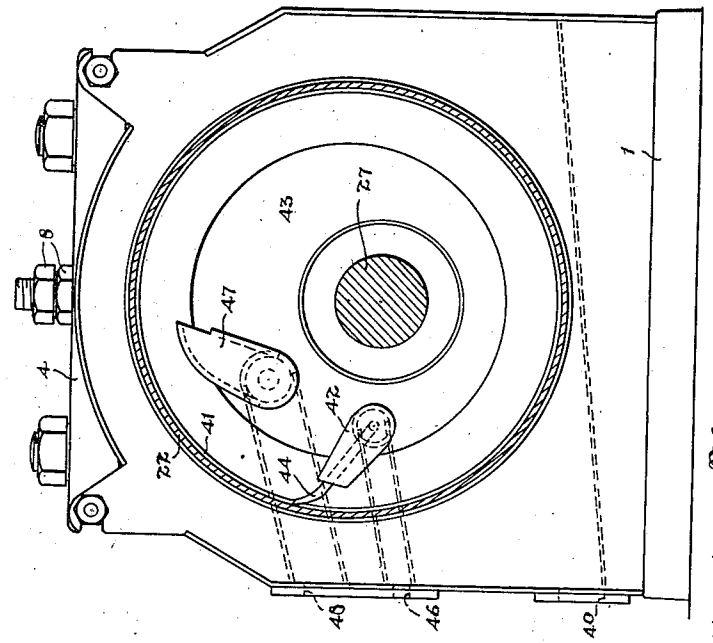


Fig. 5.

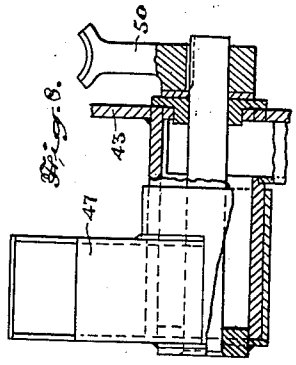


Fig. 8.

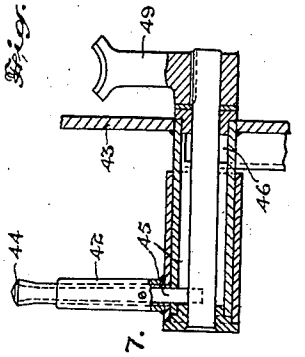


Fig. 7.

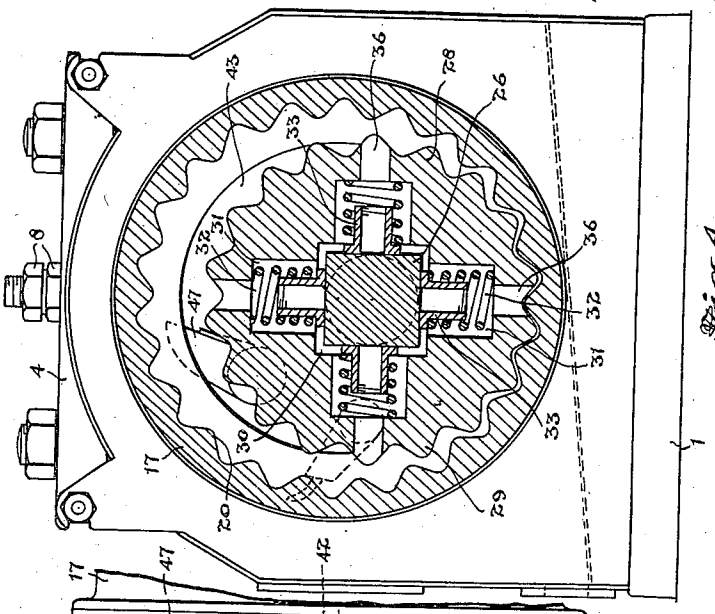


Fig. 4.

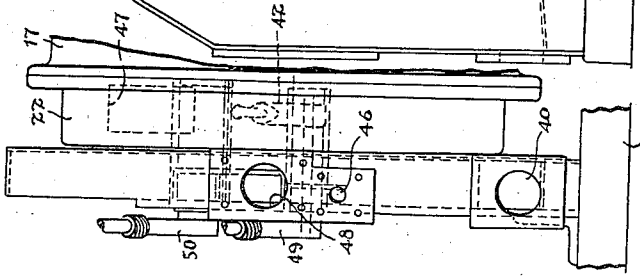


Fig. 6.

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Patented Jan. 11, 1938

2,105,003

UNITED STATES PATENT OFFICE

2,105,003

ORE CRUSHING MACHINE

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Application April 11, 1934, Serial No. 720,020

9 Claims. (Cl. 83—9)

The principal objects of this invention are to devise a crusher which will grind metalliferous ores to any desirable degree of fineness for the final extraction of the mineral values, in the minimum of time and at extremely low cost.

A further and very important object is to provide a machine which will accurately classify the ground ore permitting the separate and independent continuous extraction of the gangue, minerals and ore pulp from the machine.

Still further objects are to devise a mechanism which will permit a wide range of adjustment of crushing pressures in accordance with the hardness or toughness of the ore under treatment, and which will occupy a comparatively small space.

The principal features of the invention consist in the novel construction and arrangement of a plurality of toothed crushing members within an internally toothed rotatable drum whereby the ore is fed between the cooperating toothed surfaces and is progressively reduced by the crushing surfaces to the desired state of fineness and further, in the arrangement of a circular chamber in which the ground ore is centrifugally separated into classified zones by the centrifugal action from which it is removed by separately adjustable scoop devices.

Further features of importance consist in the novel manner of supporting the crushing members within the rotatable drum upon a shaft which may be adjusted radially and to which pressure may be variably applied to vary the spacing between the co-operating crushing surfaces and the pressure applied in crushing the ore.

In the accompanying drawings, Figure 1 is a longitudinal vertical mid-sectional view of the machine.

Figure 2 is an elevational view of the feed end of the machine.

Figure 3 is an elevational view of the discharge end of the machine.

Figure 4 is a vertical cross section of the machine taken through the line 4—4 of Figure 1.

Figure 5 is a vertical cross section of the machine taken through the line 5—5 of Figure 1.

Figure 6 is an elevational view of the discharge portion of the machine.

Figure 7 is a part sectional view of one of the scoops employed with its adjustable supporting means.

Figure 8 is a similar view to Figure 7 showing another type of scoop employed.

In the form of the machine here shown the base 1 has arranged thereon at opposite ends the pairs of rigid vertical standards 2 and 3, the upper ends of which are connected by the cross bars 4 and 5 respectively, which cross bars are preferably formed with centrally arranged bosses 6 which are open at the top and have centrally arranged holes through the bottom. Rods 7 extending vertically through the holes in the bosses 6 are provided with threaded upper ends on which are mounted the adjusting nuts 8 which engage spiral compression springs 9 surrounding the rods within the hollow bosses. The lower ends of the rods 7 are formed with eyes 10 and trunnion bearings 11 are supported on bolts 12 which pass through the eyes of said rods.

Cylindrical blocks 13 slidably mounted on the standards 2 and 3 are formed with inwardly extending recessed bosses which receive the trunnion ends 14 of the members 11.

Spiral compression springs 15 encircle the standards 2 and 3 above the blocks 13 and collars 16 threaded on said standards provide means for adjusting the downward pressure of the springs against said blocks.

A cylindrical drum 17 is arranged horizontally between the standards 2 and 3 and it is rotatably mounted upon the pairs of rollers 18 and 19 mounted in suitable bearings on the base 1. The inner wall of the cylinder 17 is preferably formed with teeth 20 which extend longitudinally thereof from end to end. These teeth are preferably of V shape and are rounded at root and apex.

The ends of the drum 17 are preferably flanged and at one end is secured a flanged internally geared ring 21 and at the other end is secured a collector cowl 22, the latter being formed with an inwardly extending flange 23 of considerable depth.

A journal bearing 24 is mounted on the base adjacent to the gear ring 21 and a shaft 25 journalled in said bearing is provided with a gear pinion 26 which meshes with the internally geared ring 21 to rotate the drum, suitable means for driving the shaft being arranged at its outer end. A shaft 26, preferably square in cross section, is provided with cylindrical ends 27 which are journalled in the trunnion bearings 11, the shaft extending longitudinally through the drum with its axis eccentric to the axis of the drum.

Encircling the shaft 26 and arranged within the drum 17 are a plurality of crushing discs 28, the perimeters of which are of lesser diameter than the interior of the drum and are preferably formed with teeth 29 which mesh with the teeth 20 at the bottom of the inner wall of the drum. The squared orifices 30 of the crushing

discs 28 are of larger diameter than the squared shaft 26 and cylindrical recesses 31 are formed extending outwardly into the discs from the sides of the orifices 30. Compression springs 32 are housed within the recesses 31 and these surround flanged shoes 33 which bear against the flat surfaces of the shaft. The springs 32 hold the discs in spring suspension from the shaft so that the discs will be in resilient contact with the internally toothed surface of the drum to relieve the shaft from direct crushing shocks. The square shaft being thus loosely fitted in the larger square orifices of the crushing discs, the discs are thereby permitted to yield independently a limited distance in either a radial or circumferential direction or both, relative to the shaft in opposition to the spring pressure influence which constantly tends to retain the crushing discs in or return same to a normal relation to the shaft.

The shaft 26 is provided with a central bore 34 extending inwardly from the end adjacent to the driven end of the drum and lateral passages 35 extend radially outward to discharge ore pulp into the recesses 31 of one or more of the crusher discs, said discs being provided with openings 36 extending radially outward through the toothed periphery.

A feed funnel 37 is mounted on the bearing 11 at the open end of the shaft 26 and has a cylindrical end 38 extending into the bore 34 which is sealed by a suitable packing 39.

The ore pulp or suitably crushed ore and water in desired proportions, is fed into the funnel 37 and flows through the bore 34 of the shaft and through the passages 35 in the crusher discs to the toothed periphery where crushing takes place as the teeth of the discs mesh with the teeth of the drum, the drum being driven through the medium of the pinion 26 and internal gear ring 21 described.

The ore pulp discharged into the drum adheres to the toothed inner wall through centrifugal force or gravity and is crushed by the intermeshing teeth of the drum and discs and flows longitudinally of the drum being crushed progressively by the plurality of discs until, having reached the discharge end of the cylinder, it flows into the cowl 22.

It will be readily understood that the weight of the shaft and the crushing discs is suspended by the spring supported rods 7 and said rods may be adjusted to hold the engaging toothed surfaces at any desired co-operative position. The compression springs 15 may be adjusted to apply any desired degree of pressure to effect the crushing of the ore particles flowing between the crushing surfaces. It will thus be understood that the machine may be adjusted in perfect balance but it will also be seen that one end of the shaft may be adjusted so that the spacing of the intermeshing crushing surfaces may be greater at one end than the other and that such spacing may be regulated to effect any desired result, that is, so that crushing from coarse particles at one end to any desired degree of fineness or screen at the other.

The centrifugal force of the rotation of the drum causes the heavier materials to adhere closely to the wall of the inner periphery of the drum and when the finally pulverized material flows into the cowl 22 the heavier particles flow to the periphery while the progressively lighter particles flow in extractable zones, that is to say, into different zones, from which the classified finely ground particles may be removed or extracted and is intended to mean that different zones of extraction exist between the outer periphery of the cowl 22 and points more closely adjacent the axis thereof. The gangue and water flow over the flange 23 and are conducted to the discharge passage 40 and the metal particles, if any, will flow to the periphery of the cowl and will gather in a groove 41 therein.

A scoop device 42 is rotatably mounted in the end wall 43 of the cowl and has a small end 44 which will extend into the groove 41 and pick up the heaviest particles. The scoop is formed with a conduit portion 45 which leads to the discharge opening 46.

A scoop 47 having a wider entrance end than the scoop 42 is also mounted in the end wall of the cowl and is adapted to pick up material from a zone different from that from which the scoop 42 obtains its supply and this scoop discharges through the opening 48.

Both the scoops 42 and 47 are rotatably mounted to be moved into varying positions in relation to the peripheral wall of the cowl and each is provided with a quadrant 49 operated by a worm 50 to which a suitable hand wheel is secured.

It will be appreciated that with a device such as described the crushing discs may be adjusted in a very wide range to accomplish the desired results and that the crushed material is classified by the centrifugal action and may be picked up by the adjustable scoop members at varying positions. Only two scoops are shown but any desired number may be employed.

With such a device the crushing is effected with the minimum expenditure of power and the power applied is utilized to effect the classifying of the resultant pulp. Thus, not only is the power expended utilized to the greatest advantage, but the entire equipment is extremely compact and further, much equipment is saved in the elimination of a separate classifier device.

The structure shown is of a desirable and practical form, but it will be readily understood that considerable variation may be made in the design of the machine without departing from the essential elements thereof.

It will also be appreciated that by varying the proportion of water and ore pulp fed into the machine a wide variation in the fineness of the final product may be accomplished owing to its speed of passage from the feed to the discharge end.

Another feature of importance is that the classifying is not necessarily dependent upon centrifugal action, and if desired the ground pulp may be discharged into a receptacle where classification will take effect through gravity.

What I claim as my invention is:—

1. An ore crushing machine, comprising in combination a horizontal rotatable drum, means for rotating said drum, standards mounted adjacent to each end of said drum, a journal bearing supported from said standards at each end of said drum, a shaft journalled in said bearings and extending through said drum, a progressive series of crushing elements mounted on and rotating with said shaft within the drum, spring means interposed between each of said crushing elements and said shaft whereby each element is resiliently linked with and capable of yielding relative to the others and to said shaft while the crushing efficiency of the said remaining elements is maintained, adjustable spring means exerting a downward pressure upon each end of said shaft,

said adjustable spring means acting through said shaft to simultaneously tension the spring means of all of said crushing elements and being adapted to yield when the cumulative tension on the spring means of the series of crushing elements becomes excessive, means for feeding ore pulp to one end of said drum, and means for removing the ground pulp from the other end of said drum.

2. An ore crushing machine, comprising in combination a horizontal rotatable drum, means for rotating said drum, a pair of vertical standards mounted at each end of said drum, paired blocks slidably mounted on each pair of said standards, a journal bearing pivotally supported between each pair of blocks, adjustable means for suspending said journal bearings, compression springs surrounding said standards and exerting a downward pressure against said blocks, a shaft journalled in said pivotal bearings in eccentric relation to said drum and extending therethrough with its axis disposed in substantially right angular relation to the pivot axes of said journal bearings, a plurality of crusher discs mounted on said shaft within said drum, spring means interposed between each of said discs and said shaft and having crushing tension applied thereto by the aforesaid compression springs, means for feeding ore pulp to one end of said drum, and means for removing the ground pulp from the other end of said drum.

3. An ore crushing machine, comprising a horizontal drum, crushing means mounted within said drum, means for feeding ore pulp to said crushing means at one end of the drum, an annular chamber arranged at the discharge end of the drum adapted to receive the ground products and to centrifugally classify the same, scoop members mounted on hollow pivotal supports having their inner ends adapted to pick up the classified products at variable positions from within the centrifugal classifying chamber, each of said scoop members having separate discharge conduits, toothed quadrants mounted on said scoop members, and worm shafts operating said quadrants to adjust and hold said scoops in the desired collecting position within the classifying chamber.

4. An ore crushing machine, comprising in combination, a rotatable drum, means for feeding ore to be crushed to one end of the drum, a series of individual rotary crushing elements eccentrically disposed in axial progression within said drum for successive crushing contact with the ore as it advances along within the drum, a single mounting shaft for all of said crushing elements extending through the series thereof in eccentric relation to the drum, means presenting yielding lateral pressure between said crushing elements individually and said shaft whereby each crushing member is capable of compensating movement relative to the others, said latter means forming a flexible coupling between all of said crushing elements and said shaft, said shaft being mounted for radial displacement, and resilient means acting radially on said shaft and applying crushing pressure to all of said crushing elements simultaneously through the said yielding means thereof and adapted to yield to relieve the shaft when the cumulative tension on said individual yielding means exceeds a predetermined maximum.

5. An ore crushing machine, comprising a horizontal drum, means for rotating said drum, a squared shaft extending through said drum and arranged eccentrically thereof, means supporting the ends of said shaft outside of said drum for rotary and radial displacement, a plurality of crusher discs having square holes loosely receiving said squared shaft within the drum and directly engaging the wall of the drum in peripheral crushing contact, said squared holes being of a size to permit a limited motion only of the crusher discs on the said squared shaft, compression springs arranged radially within said discs and engaging the squared faces of the shaft and supporting said discs in spring suspension whereby the discs are independently displaceable either rotatably or radially or both relative to each other and to said shaft, means for feeding ore pulp into said cylinder at one end, means for removing the ground product from the other end of the cylinder, and means applying a resilient radial downward pressure to said shaft and to the lowermost of all of said complement of radial springs simultaneously.

6. An ore crushing machine, comprising in combination, a rotatable drum, means for feeding ore to be crushed to one end of the drum, a series of individual rotary crushing elements eccentrically disposed in axial progression within said drum for successive crushing contact with the ore as it advances along within the drum, each having an opening therethrough, a single mounting shaft extending loosely through the openings of all of said crushing elements and extending beyond the drum at the ends, resilient means presenting yielding lateral pressure between said crushing elements individually and said common shaft whereby each crushing member is capable of compensating movement relative to the others, said latter means forming a flexible coupling between all of said crushing elements and the shaft, means for removing the crushed product at the other end of the drum, and adjustable means co-operating with the outer ends of said common shaft and opposing the crushing tension of the resilient means of all of said rotary crushing elements, said latter means being yieldable when the cumulative crushing tension of said elements exceeds a predetermined maximum to relieve the common shaft of excessive strain.

7. An ore crushing machine having in combination a horizontal rotatable drum, an axially disposed series of rotary crushing members in said drum, a common shaft extending through said drum and crushing members, means forming a resilient drive connection between each of said series of crushing members and said common shaft, journal blocks receiving the ends of said shaft, means pivotally and slidably mounting said journal blocks to permit upward displacement and angular tilting of said shaft, and means for urging said shaft downwardly to control the crushing pressure between the drum and crushing members.

8. An ore crushing machine having in combination a horizontal rotatable drum, an axially disposed series of rotary crushing members in said drum bearing downwardly thereagainst, a common shaft extending through said drum and crushing members, means forming a resilient drive connection between each of said series of crushing members and common shaft and adapted to be tensioned to control the crushing pressure of said members, journal blocks receiving the ends of said shaft, means pivotally and slidably mounting said journal blocks to provide for upward displacement and angular tilting of said shaft, and means acting downwardly through said pivotal mounting of said journal blocks for

forcing said blocks into pressure contact with the shaft with the crushing members bearing downwardly against the drum in crushing contact to tension the resilient drive connection between the crushing members and shaft and thereby control the crushing pressure between the drum and crushing members.

9. An ore crushing machine, having in combination a horizontal rotatable drum, an axially disposed series of rotary crushing members in said drum in crushing contact therewith, a common shaft extending through said drum and crushing members, means forming a resilient drive connection between each of said series of crushing members and said common shaft, and adapted to be tensioned to control the crushing pressure of said members, journal blocks receiving the ends of said shaft, means pivotally and slidably mounting said journal blocks to provide for upward displacement and angular tilting of said shaft, means including compression springs acting downwardly against the mounting members of said journal blocks through said pivotal mounting of said journal blocks for forcing said blocks into pressure contact with the shaft to tension the resilient drive connection between the crushing members and shaft with the crushing members in crushing contact with the drum, to thereby control the crushing pressure between the drum and crushing members, said compression springs being disposed in pairs one at each side of said shaft, supporting frame members extending transversely above said journal blocks, suspension bars pivotally connected at their lower ends to the bearing blocks and extending upwardly through the frame members between the paired compression springs, and compression suspension springs disposed between the frame members and suspension bars and exerting a resilient upward force on said suspension bars and their associated journal blocks.

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