Feb. 13, 1940. J. J. MORCH 2,190,036

ORE CRUSHER

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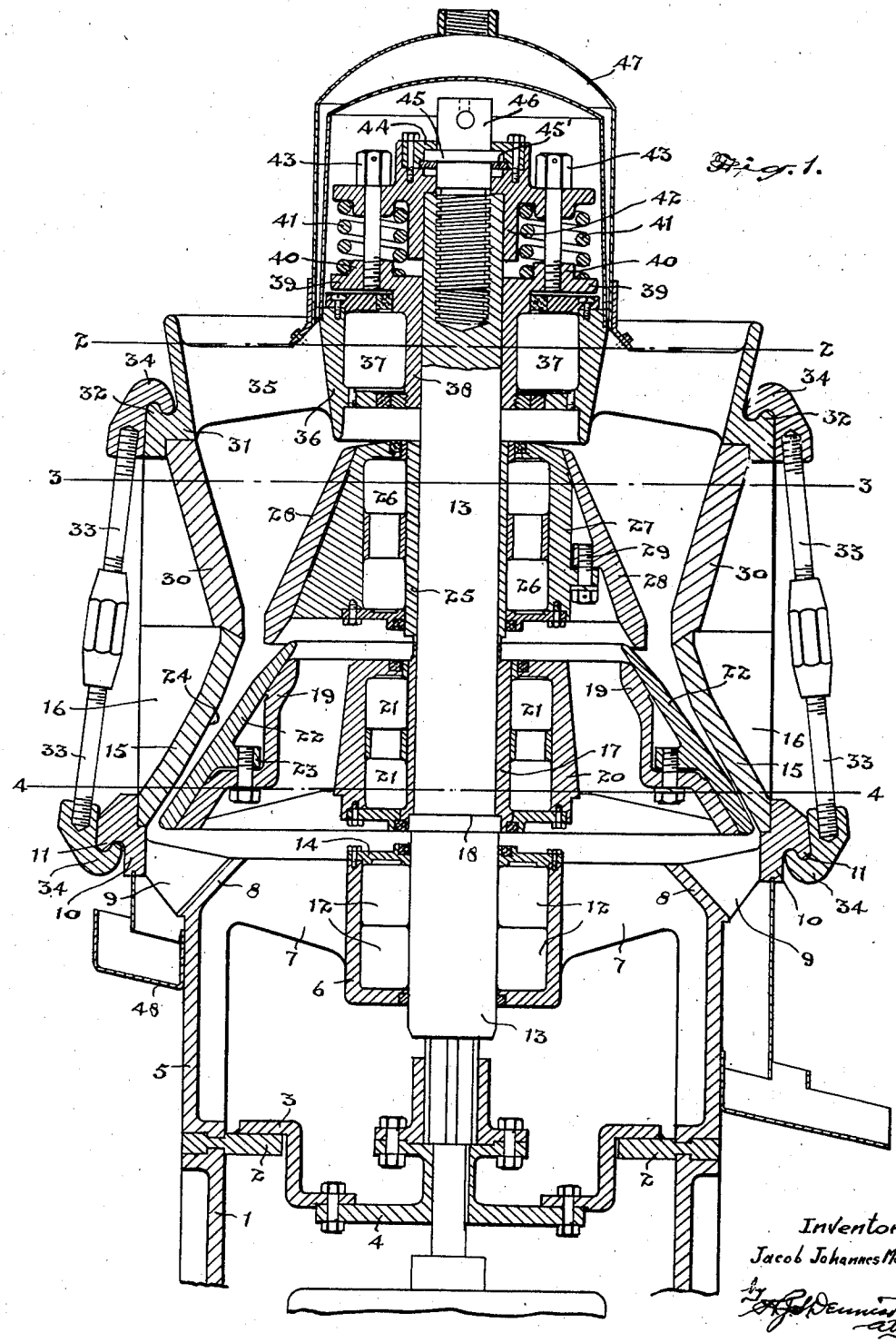

Fig. 1.

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Fig. 2.

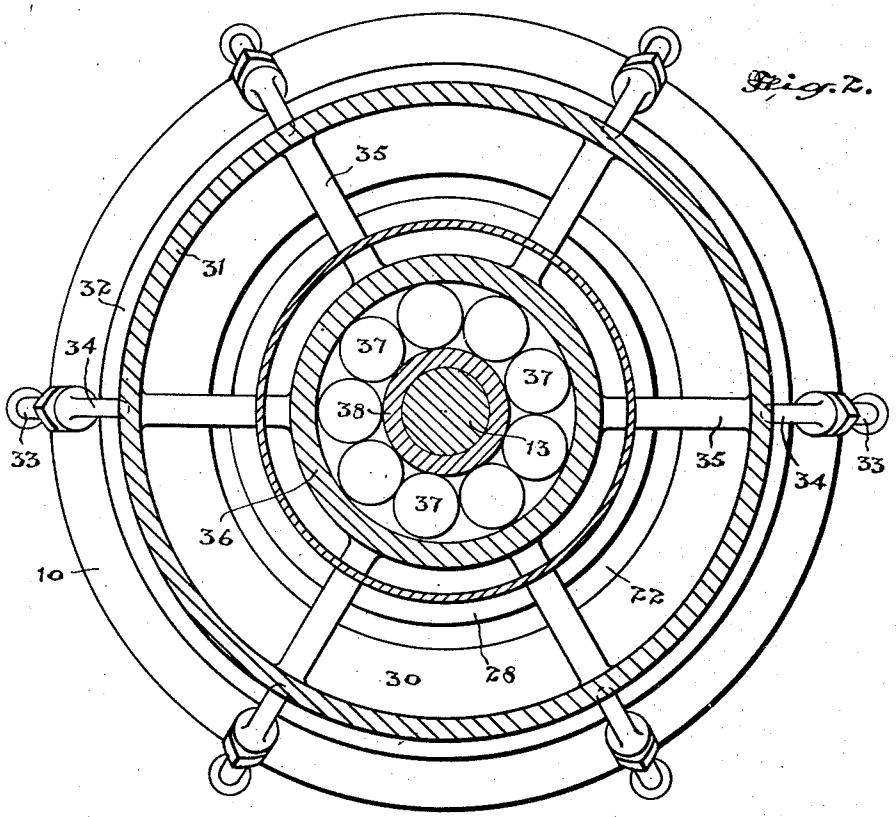
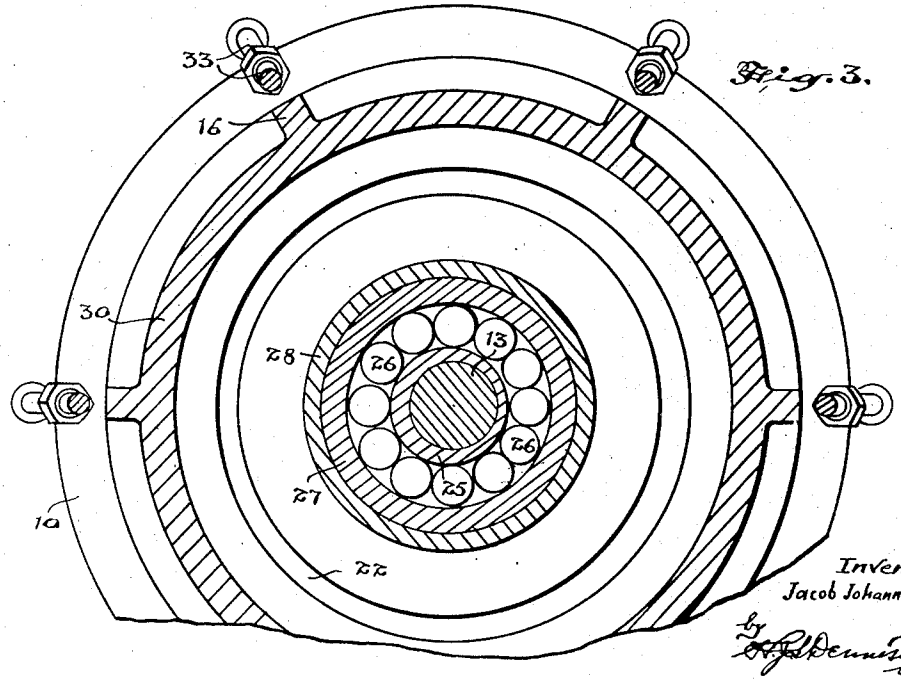


Fig. 3.



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ORE CRUSHER

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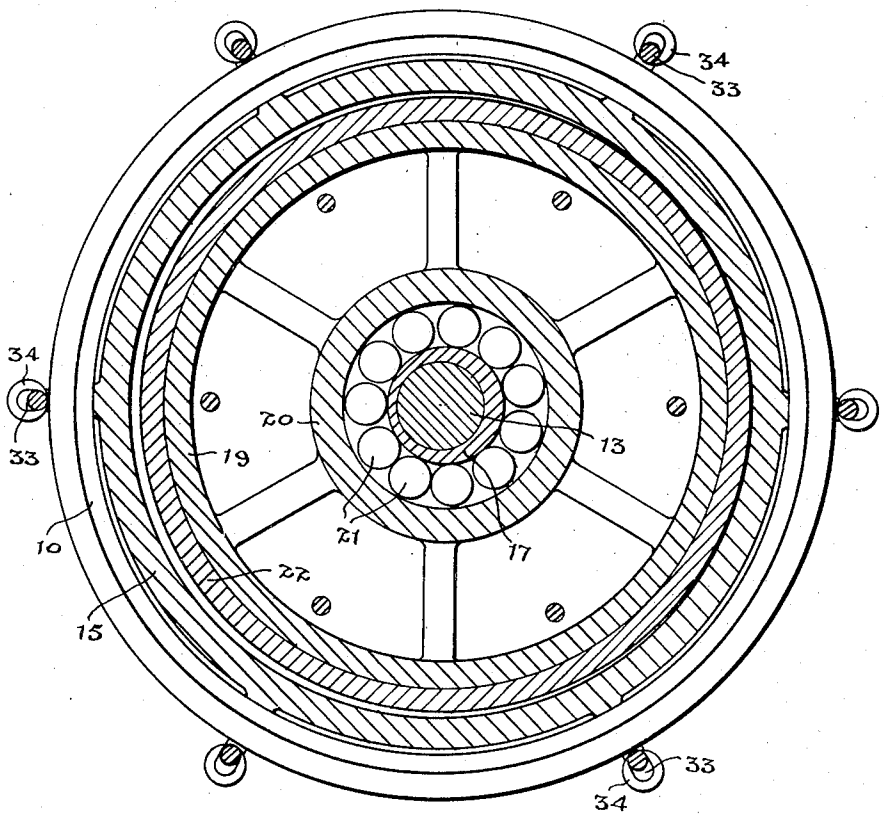
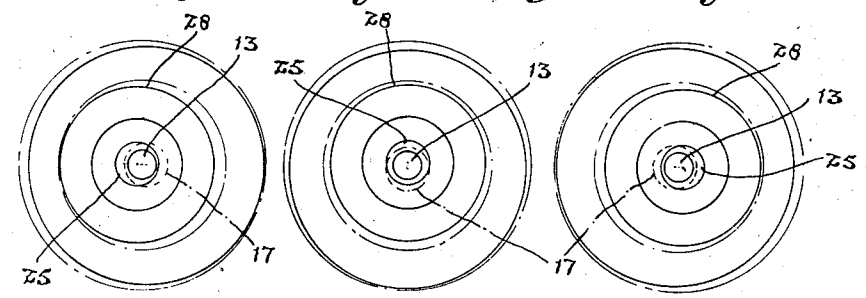


Fig. 7a Fig. 6a Fig. 4. Fig. 5a



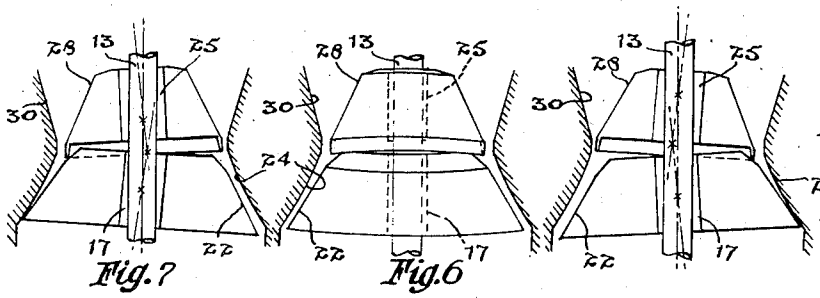


Fig. 7 Fig. 6 Fig. 5

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2,190,036

ORE CRUSHER

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In Canada August 9, 1935

10 Claims. (Cl. 83—10)

The principal objects of this invention are to provide a machine which will break up and pulverize ore to a very fine degree in a single passage through the mill and requiring the minimum amount of power, and to devise a machine which may be readily taken apart and assembled, and in which the parts are so constructed that they may be easily transported.

The principal features of the invention consist in the novel construction and arrangement of a plurality of cone-shaped crushing members obliquely eccentrically mounted upon a rotatable shaft and operating within converging and diverging crusher rings which are separably secured together forming part of the rigid frame structure in which the shaft and rotatable cone crushers are mounted.

In the accompanying drawings, Figure 1 is a vertical mid-sectional view through a crusher constructed in accordance with this invention.

Figure 2 is a horizontal sectional view through the line 2—2 of Figure 1.

Figure 3 is a horizontal sectional view through the line 3—3 of Figure 1.

Figure 4 is a horizontal sectional view through the line 4—4 of Figure 1.

Figures 5, 5*a*, 6, 6*a*, 7 and 7*a* are a series of diagrammatic plan and sectional elevational views illustrating the opposed obliquely eccentric mounting of the crusher cones in centralized and extreme right and left positions.

In the use of ore-crushing machinery it is frequently necessary to transport the same over exceedingly rough trails or even by aeroplane and while the nature of these machines requires to be exceedingly strong, yet the parts must be of such size and shape as to be readily portable.

In the construction herein shown the base 1, which is of cylindrical form is adapted to contain the motor for driving the shaft of the mill. On this base is mounted a ring 2 which carries a flange plate 3 of dished formation, upon which is mounted a vertical journal bearing 4.

A cylindrical member 5 of a diameter substantially corresponding with that of the base 1 is mounted on the ring 2 and is provided with a central bearing boss 6 supported by a plurality of radial arms 7. The upper end of the member 5 is formed with an inwardly bevelled portion 8 and a plurality of radial arms 9 extending outwardly therefrom carrying the flange ring 10 which has a downwardly extending flange 11.

Suitable roller bearings 12 are mounted within the boss 6 to support the vertical shaft 13 which is connected with the motor arranged in the base through the bearing member 4. The top of this boss is covered by a sealing plate 14 with a suitable sealing ring surrounding the shaft to prevent water and dirt from entering the bearing.

A ring 15 which forms a crusher shell is of a frustro-conical form and is mounted in the flange ring 10 being reinforced at intervals by radial exterior ribs 16. An eccentric sleeve 17 is mounted on the shaft 13 above a shoulder 18 in horizontal alignment with the crusher ring 15, the axis of said eccentric being slightly offset obliquely in relation to the axis of the shaft. Around this eccentric sleeve is arranged a cone structure 19 provided with a hollow central boss 20 enclosing a roller bearing 21 which is suitably sealed at both top and bottom.

A crusher ring 22 of frustro-conical form is mounted on the cone 19, it being provided with inwardly extending lugs 23 which extend into recesses in the cone 19 and are bolted thereto. This crusher ring is preferably formed of cast steel and its periphery is frustro-conical and converges inwardly from the inner wall 24 of the crusher ring 15, so that the space between the inner wall of the crusher ring and the cone at the top is much wider than it is at the bottom, and the oblique eccentricity of the sleeve 17 is such that the external diameter of the bottom edge of the cone approaches very closely to the lower portion of the crusher ring 15. This space may be adjusted so that the cone and ring practically touch to regulate the size of the pulverized material that is finally passed through the mill.

An eccentric sleeve 25 is obliquely mounted on the shaft 13 above the sleeve 17 and its axis is offset in relation to the axis of the eccentric 17 and is preferably arranged at a greater angle of obliquity from the shaft axis than is the axis of the eccentric 17. A roller bearing 26 surrounds the sleeve 25 and supports a cone 27 which carries a cast steel crusher cone 28 in the form of a frustro-conical ring which is supported by lugs 29 in an adjustable position. The lower edge of the upper crusher ring 20 overlaps the upper edge of the crusher ring 22 and directs material downwardly to the space between the rings 15 and 22. The greater angle of obliquity of the upper cone causes a greater tilting crushing movement which is very effective in crushing the larger rocks entering the upper hopper.

A crusher ring 30 of inverted frustro-conical form is mounted upon the ring 15 and with the cone ring 28 forms a hopper of circular form but the inner wall of the hopper is eccentric to the outer wall.

It will be understood that through the rotation of the shaft 13 the obliquely mounted sleeves 17 and 25 will cause the crusher cones carried thereby to oscillate laterally and with a tilting action within the crusher rings, and the combined vertical and horizontal action of altering the space between the cone and the surrounding ring produces a very positive crushing effect. The changing relation of the cones and crusher rings is very clearly illustrated in the diagrammatic illustration of Figures 5, 6 and 7, and 5*a*, 6*a* and 7*a*. Figures 6 and 6*a* show the relative position of the cones and rings across the aligned position of the axes of the eccentrics with the shaft. Figures 5 and 5*a* illustrate the right tilt of the upper cone concurrent with the left tilt of the lower cone while Figures 7 and 7*a* illustrate the left tilt of the upper cone with the right tilt of the lower cone. The cones are mounted on roller bearings so that while the shaft rotates freely to operate the eccentrics, the crushing cones are operated with an oblique rotary oscillation.

A ring 31 is mounted on the top of the crushing ring 28 and is provided with a flange 32 extending upwardly to correspond with the flange 11 of the ring 10.

A plurality of fastening devices in the form of turn-buckle rods 33 provided with hook ends 34 to hook over the flanges of said rings are arranged around the assembly and are tightened to hold the rings in position.

The ring 31 is provided with a plurality of inwardly extending radial arms 35 which support a tapering and hollow boss 36 within which is mounted a roller bearing 37, which bearing engages a sleeve 38 mounted on the shaft 13. This sleeve is concentric with the shaft and the shaft is capable of sliding movement therein. The sleeve is provided with a flange 39 at the top formed with a plurality of bosses 40, and spiral compression springs 41 are mounted on this flange around said bosses. A similarly flanged sleeve 42 engages the springs and is held in position by the cap screws 43.

A flange plate 44 is secured in the top of the sleeve 42 and engages the annular flange 45 on a jack screw 46 which is threaded into the end of the shaft 13. By operating the jack screw the pressure of the springs 41 which resiliently opposed longitudinal crushing thrusts may be increased or decreased to resist downward pressure against the shaft through the effect of crushing rock in the annular spaces between the cone crushers and the ring crusher and the crushing clearance and pressure between the crusher rings 15 and 22 may in this way be varied.

A safety shear ring 45' is mounted in a groove in the ring 44 and engages the underside of the flange 45 and suspends the shaft. In the event of a sudden overload caused by jamming of rocks in the crusher the ring 45' will shear and relieve the stress.

A water bell 47 is arranged over the end bearings of the shaft and pours water downwardly on the outside of the central boss of the top frame ring. This water pours into the converging hopper formation between the upper crusher ring and the upper cone, and crushed rock is washed downwardly, flowing over the bevel 8 of the member 5 into a trough 48 surrounding the member 5 which carries off the ground material.

It will be understood that in the operation of this machine, as the shaft is rotated in its fixed bearings the eccentric sleeves obliquely mounted thereon carry the bearings engaging therewith, upon which the crushing cones are supported, in an eccentric oblique oscillation, thus rolling the cone members around into a varying spaced relationship with the surrounding crusher rings. These eccentrics can be adjusted to regulate the spacing to any desired degree by the shifting of the cone crusher members on their supporting members, and in the comparatively rapid movement of rolling oscillation, the particles of rock are gripped and crushed and the finest ground particles filter through and are finally carried away in the trough 48.

It will also be noted, particularly on reference to the sectional diagrams in Figures 5 to 7 and 5*a*, 6*a* and 7*a*, that the rotary oscillation of the pair of crusher cones, being carried on oblique axes, imparts to each cone a tipping movement toward and from the wall of the crusher rings, and as the lower edge of the upper cone 28 draws away from the encircling ring 30, allowing the smaller particles of rock to fall through, the skirt of the lower cone 22 immediately therebelow is tilted into close proximity to the ring surface 24, thus catching and holding the particles of rock until they are pulverized to the finest possible degree in accordance with the setting of the cones.

It is important to note that with the construction herein described the double cone arrangement is such that the discharge of rock from the upper cone to the lower may be synchronized in such manner that the feed to the lower cone will be in proportion to the degree of fineness of material required in the final product.

Further it will be noted that a four point crushing is achieved with the two eccentrically and obliquely mounted cones since the eccentric displacement of each cone will set up a crushing action in one zone while the wabble effect due to the oblique mounting will set up a crushing action in another zone.

The oblique eccentricity of the respective cone axes is such that the cone axes are disposed in planes which intersect one another or it may be said that the cone axes have a substantial focal point intermediate of the height or length of cones producing a wabble that creates a crushing effect on opposite sides reducing the bending moment and facilitating discharge.

The structure of the machine is such that it may be very readily dis-assembled. The upper bearing ring section may be lifted off the top crusher section and the top crusher section taken from the lower one and the lower one taken from the upper space ring. Similarly the cones may be separated so that all the parts may be of such size and weight as may be handled readily under difficult transport conditions. Owing to this readiness of dis-assembling, broken parts may be readily replaced or parts may be removed for repair.

What I claim as my invention is:

1. An ore crusher having superposed converging and diverging crusher rings, a shaft concentric therewith, and cones eccentrically mounted in offset angular relation to each other to rotate on said shaft and oscillate within respective rings, the axes of said cones being arranged at oblique angles in diverging relationship to each other.

2. In an ore crusher of the type having superposed separable converging and diverging crusher rings and a shaft concentric therewith, cones eccentrically and obliquely mounted to rotate on said shaft in co-operative crushing relation to

said respective rings, the oblique axes of said cones having a substantially common focal point intermediate of the depth of the cones.

3. In an ore crusher of the type having superposed separable converging and diverging crusher rings and a shaft extending therethrough, crusher cones eccentrically and obliquely mounted on said common shaft for rotation relative thereto and co-operative with respective crusher rings, the obliquity of the axis of one of said cones being greater than the obliquity of the next succeeding cone.

4. In an ore crusher of the type having superposed converging and diverging crusher rings, and a shaft concentric therewith, cones obliquely mounted to rotate on said shaft in co-operative crushing relation to said respective rings, the oblique axes of said cones crossing the shaft exis within the axial length of the respective cones and each diverging therefrom to pass through a transverse plane at a point intermediately between the end extremities of said cones.

5. In an ore crusher of the type having axially converging and diverging crusher rings disposed in axial progression and crusher cones disposed within and respectively co-operative with said crusher rings, the combination therewith of means for differentially tilting said crusher cones about the axis of the crusher rings including a drive shaft for said crusher cones having an axis fixed in relation to said crusher rings and extending therethrough.

6. An ore crusher having superposed converging and diverging crusher rings, a shaft journalled centrally of said rings, a crusher cone obliquely eccentrically mounted on said shaft to operate with a rotative tilting movement in relation to the converging ring, and a second crusher cone obliquely eccentrically mounted on said shaft to operate with a tilting rotative movement in relation to the diverging ring, the eccentric mounting of the crusher cones being such that as a point on the bottom edge of the lower cone is eccentrically tilted toward its cooperating ring a corresponding point on the bottom edge of the upper cone is eccentrically tilted away from its co-operating ring.

7. In an ore crusher having superposed converging and diverging crusher rings and a shaft concentric therewith, cones obliquely eccentrically mounted to rotate about said common shaft on independent axes so that each is tilted and displaced relative to the other in co-operative relation to its respective ring, said cones each diverging downwardly in close-coupled relation, with the lower divergent end of the upper cone overhanging the upper convergent end of the lower cone in telescopic non-contacting relation permitting the said relative tilting of the cones in their close-coupled relation while directing the crushed material from the upper cone over the outer crushing surface of the lower cone.

8. An ore crusher having a peripheral crushing surface, a shaft mounted with its axis in fixed concentric relation to the axis of said peripheral crushing surface, and a crushing member rotatable about an axis which is obliquely disposed to the fixed axis of the said shaft and which intersects the shaft axis substantially centrally of the axial length of the crushing member, whereby said crushing member presents a substantially balanced double peripheral crushing co-operation with said crushing surface.

9. An ore crusher as claimed in claim 8 in which the oblique axis is eccentrically offset from the shaft axis in addition to being obliquely related thereto.

10. In an ore crusher of the type having superposed separable converging and diverging crusher rings and a shaft concentric therewith, the combination therewith of cones obliquely mounted in oppositely offset relation to each other to independently rotate on said shaft and oscillate each about a zone substantially centrally of its axial length within its respective ring, the oblique mounting being such that a point on the bottom edge of the lower cone is tilted toward its co-operating ring as a corresponding point on the bottom edge of the upper cone is tilted away from its co-operating ring.

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