Sept. 15, 1925. 1,553,333

J. M. SHOLL ET AL

CRUSHING APPARATUS

Filed Aug. 3, 1922 2 Sheets-Sheet 1

Fig. 1.

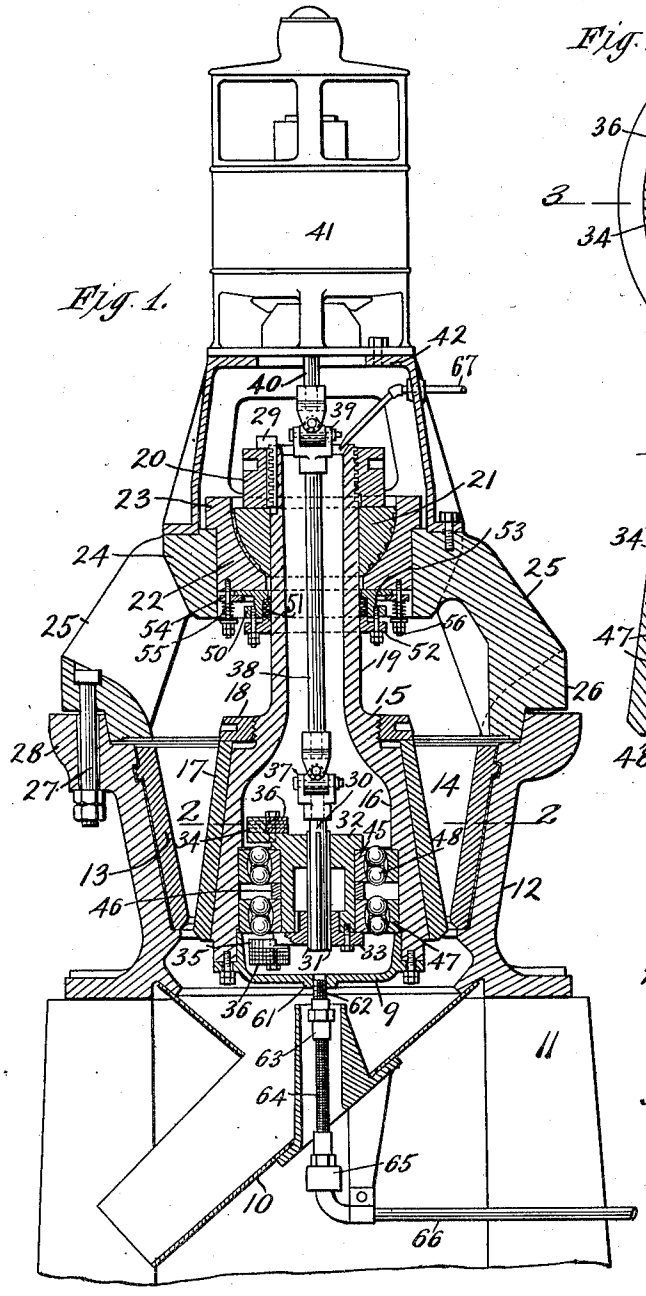


Fig. 2.

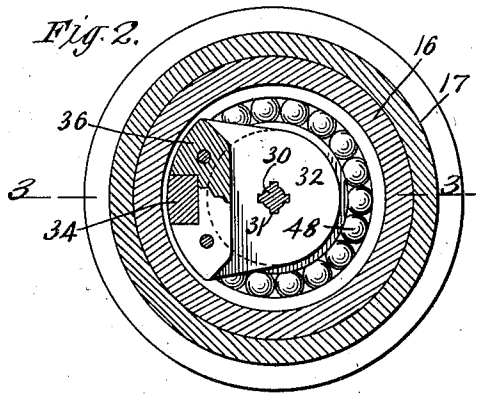


Fig. 3.

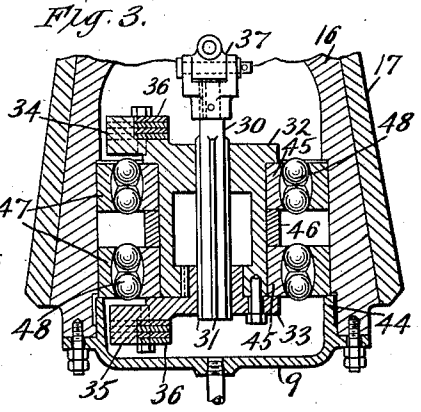
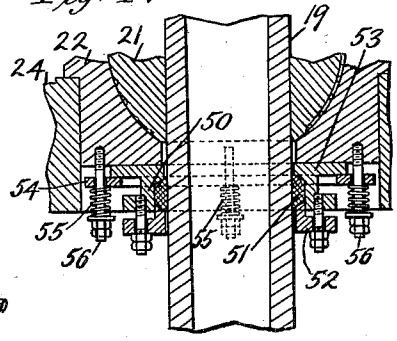


Fig. 4.



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Fig. 5.

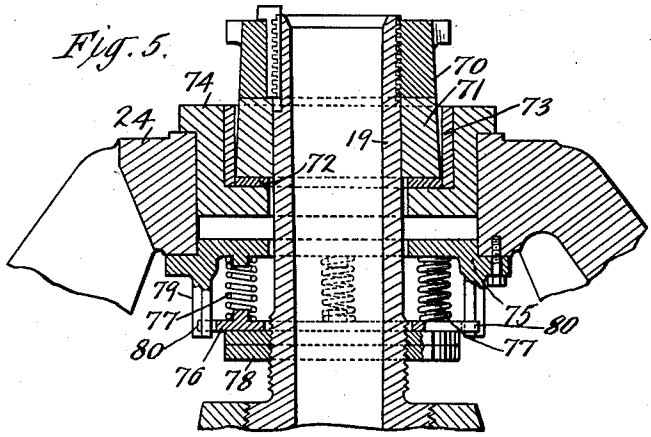
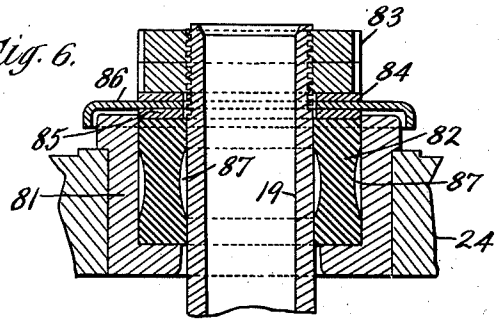


Fig. 6.



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Patented Sept. 15, 1925. 1,553,333

UNITED STATES PATENT OFFICE.

JACOB M. SHOLL AND ERNEST E. PFEFFER, OF MILWAUKEE, WISCONSIN, ASSIGNORS, BY MESNE ASSIGNMENTS, TO ALLIS-CHALMERS MANUFACTURING COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF DELAWARE.

CRUSHING APPARATUS.

Application filed August 3, 1922. Serial No. 579,524.

To all whom it may concern:

Be it known that we, JACOB M. SHOLL and ERNEST E. PFEFFER, citizens of the United States, residing at Milwaukee, county of Milwaukee, and State of Wisconsin, have invented certain new and useful Improvements in Crushing Apparatus, fully described and represented in the following specification, and the accompanying drawings, forming a part of the same.

This invention relates to improvements in crushing apparatus of that type employing a swinging head and in which the crushing pressure is produced or controlled by centrifugal force.

It is one of the principal objects of the invention to provide a crushing apparatus adapted to fine crushing and capable of a large capacity and a high ratio of reduction.

It is a further object of the invention to provide a crushing apparatus that is more economical to manufacture than existing machines of a like capacity.

With these general objects in view the invention consists in the combinations, details of construction and arrangements of parts which will first be described in connection with the accompanying drawings and then more particularly pointed out.

In the drawings:

Fig. 1 is a view in vertical cross section of a crusher constructed in accordance with the invention;

Fig. 2 is a cross sectional view (enlarged) taken on the line 2—2 of Fig. 1;

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 2;

Fig. 4 is an enlarged view of part of Fig. 1;

Fig. 5 is a view in vertical section of part of a crusher showing a modified construction; and

Fig. 6 is a similar view showing a further modification.

Referring to the drawings, in the embodiment of the invention here illustrated as an example, a base 11 supports a casing or shell 12 having sectional liners or concaves 13. This shell, with its liners, forms the crushing chamber 14. Located in the crushing chamber and coacting with its concaves to crush the material is a crusher head 15. This head, as here illustrated, comprises a conical head-center 16 on which is mounted a conical mantle 17, a nut 18 securing the mantle in place. With the construction described the mantle may be made of a special and hard metal and may be readily renewed when desired. Secured to the bottom of the head-center to close the latter and exclude dust is a cover 9. Below the crushing chamber is a discharge chute 10.

There is provided a universal suspension for the crusher head which may comprise, for example, a ball and socket bearing. Although capable of various constructions, in that illustrated in Fig. 1, the crusher head-center 16 has a cylindrical shank 19 threaded at its upper end to receive a nut 20 by which the down thrust of the crusher head is taken by the ball and socket suspension. On the shank 19 below nut 20, is a suspension ball 21 seating in the socket of a suspension block 22. This block is supported by means of a flange 23 from a hub 24 connected by arms 25 with a spider 26. Spider 26 is secured by bolts 27 or the like to a rim or flange 28 on the casing 12.

In order to vary the discharge opening of the V-shaped crushing chamber 14, the vertical position of the crusher head may be adjusted by varying the position of nut 20 in shank 19. To hold nut 20 in a given position a key 29 is provided.

The invention includes a weighted body, which may, for example, be unbalanced, rotatable within the crusher head and free to shift is axis, the crusher head being actuated by this rotating body. While the unbalanced body may have various constructions, in that illustrated as an example, mounted on a shaft 30 by means of a plurality of splines 31 is a cage 32 to which is secured a flange 33. Cage 32 has a lug 34 and flange 33 has a similar lug 35. To these lugs are secured variable weights 36, notched, as shown in Fig. 2, to embrace part of the lugs 34, 35. It will be clear from Figs. 2 and 3 that the element comprising cage 32, flange 33 with the weights arranged as shown, is unbalanced with respect to its axis of rotation. As a result, there is set

up, upon rotation of shaft 30, an unbalanced centrifugal force measured by the unbalanced weight and the speed of rotation.

There is provided a flexible driving connection for rotating the unbalanced body on its own axis. Although capable of various constructions, in the embodiment illustrated, shaft 30 is connected by a universal joint 37 with an intermediate shaft 38. This shaft, in turn, is connected by a universal joint 39 with a drive shaft 40. The drive shaft 40 is driven by a high-speed motor 41 supported on a bracket 42 secured to the hub 24. With the construction described, the driving connection can flex as the axis of shaft 30 shifts during rotation.

Provision is made for centering the unbalanced body in the crusher head. While this may be accomplished in various ways, in the embodiment illustrated the cage 32 carries two ball-bearing races 45 spaced by a ring 46 and the crusher head carries two corresponding races 47, the lower race 47 being supported by flange 44 on cover 9. Rolling between the respective races are ball bearings 48. When the unbalanced body is rotated by the motor the centrifugal force set up is transmitted to the crusher head through the ball bearing connection described and the crusher head is actuated. By this movement of the crusher head, the material fed to the crushing chamber 14 through the openings between arms 25 is crushed.

There is provided a dust and oil sealing device for the ball and socket suspension of the crusher head. Although capable of various constructions, as here shown as an example, encircling the shank 19 is a stuffing box 50 having a packing ring 51 which is pressed against the shank by a gland 52. The stuffing box has a flange 53 yieldably clamped against the bottom of the bearing block 22 by means of a ring 54 pressed against the flange 53 by springs 55. These springs bear against the heads of pins 56 secured to the bottom of block 22. As the shank 19 moves, the stuffing box moves with it but is at all times clamped against the bearing block. The construction described excludes dust from the ball and socket bearing and retains the lubricating oil in the bearing.

Structures embodying the invention in its entirety include provision for a circulation of oil through the crusher head, whereby the ball bearings may be lubricated and the crusher head cooled. As here illustrated as an example, the cover 9 has a perforate boss 61 at its central point and in this boss is inserted a pipe 62 in telescopic relation with a coupling 63. The coupling 63 is connected by a flexible hose 64 and a coupling 65 with a pipe 66 leading to a filter, pump or the like (not shown). Carried by bracket 42, adjacent the top of shank 19 is an oil feed pipe 67 leading from a source of oil (not shown). With the construction described, oil delivered to the top of the shank 19 circulates through shank and head-center 16 and out via pipe 62. The oil in its circulation not only serves to lubricate the ball bearings in the crusher head but also absorbs and carries away heat generated in operation of the apparatus.

In Fig. 5 is illustrated a modified form of universal suspension for the crusher head. As shown, the shank 19 is threaded at the top to receive a nut 70 bearing on a conical sleeve 71 on the shank. This sleeve rests on a washer 72 and is embraced by a bushing 73, both washer and bushing being carried by a shouldered ring 74 supported by hub 24.

There is provided means for maintaining the axis of the crusher head on the axis of the apparatus. As here shown as an example, fastened to the lower side of hub 24 (Fig. 5) is a flange 75. Between this flange and a ring 76 are springs 77, the ring 76 resting on the top of a nut 78 threaded onto shank 19. The pressure of springs 77 on ring 76 is transmitted by nut 78 to shank 19 which, in turn, transmits it by nut 70 to the sleeve 71, thereby forcing sleeve 71 down against washer 72 and holding shank 19 on the axis of the apparatus. Arms 79 on the flange 75 engage lugs 80 on the ring 76 to prevent rotation of the latter.

In Fig. 6 is illustrated a further modified form of crusher head suspenion. As shown, mounted in a shouldered suspension ring 81 carried by hub 24 is a resilient sleeve 82, of rubber or the like, encircling the shank 19. The thrust of the crusher head is transmitted to this rubber sleeve by a nut 83, threaded onto the top of shank 19, and washers 84, 85. Between the washers is a guard plate 86 to keep oil away from the rubber sleeve. The outer and inner cylindrical surfaces of the rubber sleeve are formed with concave recesses 87 to permit expansion of the sleeve under pressure.

The operation of the apparatus will be clear from the above without further description.

What is claimed is:

1. In a crushing apparatus, a crusher casing forming a crushing chamber, a weighted body rotatable on its own axis and free to shift said axis under centrifugal force developed during rotation, a flexible driving connection for rotating said body, and a crusher head having a universal suspension and actuated by the rotating body.

2. In a crushing apparatus, a crusher casing forming a crushing chamber, a weighted body rotatable on its own axis and free to shift said axis under centrifugal force developed during rotation, a flexible driving connection for rotating said body, and a

crusher head having a universal suspension and actuated by the rotating body, the rotatable body being centered in the crusher head.

3. In a crushing apparatus, a crusher casing forming a crushing chamber, a weighted body rotatable on its own axis and free to shift said axis under centrifugal force developed during rotation, a flexible driving connection for rotating said body, a crusher head having a universal suspension and actuated by the rotating body, and an annular ball bearing for centering the rotating body in the crusher head.

4. In a crushing apparatus, a crusher casing forming a crushing chamber, a crusher head having a universal suspension, an unbalanced body rotatable within the crusher head and free to shift its axis, and a flexible driving connection for rotating said unbalanced body on its own axis, whereby the unbalanced body tends to shift its axis and actuate the crusher head.

5. In a crushing apparatus, a crusher casing forming a crushing chamber, a crusher head hung from a ball and socket bearing, an unbalanced body rotatable within the crusher head and free to shift its axis, and a flexible driving connection for rotating said unbalanced body on its own axis, whereby the unbalanced body tends to shift its axis and actuate the crusher head.

6. In a crushing apparatus, a crusher casing forming a crushing chamber, a crusher head having a universal suspension, an unbalanced body rotatably centered within the crusher head and free to shift its axis, and a flexible driving connection for rotating said unbalanced body on its own axis, whereby the unbalanced body tends to shift its axis and actuate the crusher head.

7. In a crushing apparatus, a crusher casing forming a crushing chamber, a crusher head having a universal suspension, an unbalanced body rotatable within the crusher head and free to shift its axis, a flexible driving connection for rotating said unbalanced body, and annular ball bearing devices for centering the unbalanced body in the crusher head.

8. In a crushing apparatus, a crusher casing forming a crushing chamber, a crusher head having a universal suspension, an unbalanced body rotatable within the crusher head and free to shift its axis, a variable weight for said unbalanced body, and a flexible driving connection for rotating said unbalanced body on its own axis, whereby the unbalanced body tends to shift its axis and actuate the crusher head.

9. In a crushing apparatus, a crusher casing forming a crusher chamber, a crusher head having a universal suspension, an unbalanced body rotatable within the crusher head and free to shift its axis, a drive shaft, a connection including a universal joint between said drive shaft and the unbalanced body for rotating the latter on its own axis, and means for centering the unbalanced body in the crusher head.

10. In a crushing apparatus, a crusher casing forming a crushing chamber, a crusher head having a universal suspension and including a hollow shank, a cover plate on the bottom of the crusher head, a rotating body within the crusher head for actuating the latter, a pipe for delivering oil to the shank and crusher head and a pipe for carrying away the oil.

11. In a crushing apparatus, a crusher casing forming a crushing chamber, a crusher head having a universal suspension and including a shank, a nut on said shank carried by the supporting member of said universal suspension, an unbalanced body, including a splined shaft, rotatable within the crusher head, a drive shaft, and a connection including a universal joint between the drive shaft and the splined shaft, the unbalanced body being free to shift its axis and actuate the crusher head.

12. In a crushing apparatus, a crusher casing forming a crushing chamber, a weighted body rotatable on its own axis and free to shift said axis under centrifugal force developed during rotation, a flexible driving connection for rotating said body, a crusher head having a universal suspension and actuated by the rotating body, and a dust excluding device between the crushing chamber and the head suspension.

13. In a crushing apparatus, a crusher casing forming a crushing chamber, a weighted body rotatable on its own axis and free to shift said axis under centrifugal force developed during rotation, a flexible driving connection for rotating said body, a crusher head actuated by the rotating body, the crusher head including a shank and having a ball and socket suspension, and a yieldable protector between the shank and a stationary part for excluding dust in the crusher chamber from the ball and socket suspension.

14. A gyratory crusher comprising in combination, a casing provided with an inner crushing wall, an upright shaft supported within the casing for gyratory movement, a crushing roller embracing said shaft and positioned to cooperate with said inner wall, and an unbalanced wheel secured to the shaft to impart gyratory movement to the shaft and roller by the unbalanced rotation of the wheel.

15. A gyratory crusher comprising in combination, a casing provided with an inner crushing wall, an upright shaft supported at one end only for gyratory movement within the casing, a crushing roller embracing said shaft and positioned to co-

operate with said inner wall, and an unbalanced wheel mounted upon the shaft to impart gyratory movement to the shaft and roller by the unbalanced rotation of the wheel.

16. A gyratory crusher comprising in combination, a casing provided with an inner crushing wall, an upright shaft suspended from an upper bearing to rotate in the casing with gyratory movement, a crushing roller embracing said shaft and positioned to cooperate with said inner wall, and an unbalanced wheel secured to the shaft to impart gyratory movement to the shaft and roller by the unbalanced rotation of the wheel.

17. A gyratory crusher comprising in combination, a casing provided with an inner crushing wall, a hollow upright shaft suspended from an upper bearing to rotate in the casing with gyratory movement and having a crushing surface surrounding the shaft and positioned to cooperate with said inner wall, an unbalanced wheel secured to the shaft to impart gyratory movement to the shaft and roller by the unbalanced rotation of the wheel, and a second shaft mounted within the hollow shaft and rotatable to operate the unbalanced wheel.

18. A gyratory crusher comprising in combination, a casing provided with an inner crushing wall, a shaft supported for gyratory movement within the casing and having a crushing surface surrounding the shaft and positioned to cooperate with said inner wall, an unbalanced wheel rotatably mounted upon the shaft to impart gyratory movement thereto by the unbalanced rotation of the wheel, and means for rotating said wheel upon said shaft.

19. A gyratory crusher comprising in combination, a casing provided with an inner crushing wall, a shaft suspended within the casing for gyratory movement and having a crushing surface surrounding the shaft and positioned to cooperate with said inner wall, an unbalanced wheel rotatably mounted upon the shaft to impart gyratory movement thereto by the unbalanced rotation of the wheel, and a driving shaft having driving engagement with the wheel but free from the weight thereof.

20. A gyratory crusher comprising in combination, a casing provided with an inner crushing wall, a shaft supported at its upper end for free swinging movement within the casing and having a crushing surface secured to the shaft intermediate the ends of the shaft and positioned to cooperate with said inner crushing wall, and weighted means upon the lower end of the shaft and rotatable to impart gyratory movement to the lower end of the shaft so that the axis of the shaft moves in a path to generate a cone.

21. A gyratory crusher comprising in combination, a casing provided with a tapered inner crushing wall, a shaft suspended within the casing for gyratory movement, a crushing surface surrounding the shaft to cooperate with the inner crushing wall and tapered in the same direction as the inner crushing wall, an unbalanced wheel mounted upon the shaft to impart gyratory movement thereto by the unbalanced rotation of the wheel, and means for rotating said wheel.

22. In a crusher, a casing forming a crushing chamber, a crusher head within said chamber, rotatable means maintained centrally within said head, and means for unbalancing said rotatable means during rotation thereof to gyrate said head relatively to said casing.

23. In a crusher, a casing forming a crushing chamber, a crushing head within said chamber, a rotary shaft maintained centrally within said head, and means acting to unbalance said shaft during rotation thereof to gyrate said head relatively to said casing.

24. In a crusher, a casing forming a crushing chamber, a crusher head within said chamber, a shaft disposed centrally of said head, an unbalanced weight rigidly attached to said shaft, and means for rotating said shaft.

25. In a crusher, a casing forming a crushing chamber, a crusher head within said chamber, said head having an upright central axis, a shaft coaxial with said head, a weight rigidly attached to said shaft eccentrically of said axis, and means for revolving said weight about said axis.

26. In a crusher, a casing forming a crushing chamber, a crusher head gyratable within said chamber, an actuating shaft extending downwardly and disposed centrally within said head, an unbalanced weight rigidly attached to said shaft, and means located above said head for rotating said shaft.

27. In a crusher, a casing forming a crushing chamber, a crusher head within said chamber, an actuating shaft disposed within said head, bearings for maintaining said head and said shaft coaxial, an unbalanced weight rigidly attached to said shaft, and means for rotating said shaft.

28. In a crusher, a casing forming a crushing chamber, a crusher head within said chamber, a universal support for said head located above said chamber, an actuating shaft disposed and maintained centrally within said head, a weight rigidly attached to said shaft eccentrically of the axis of said head, and means for revolving said weight about said axis.

29. In a crusher, a casing forming a crushing chamber, a crusher head within said chamber, a universal suspension for said

head located above said head and said chamber, an actuating shaft disposed within said head, bearings for positively maintaining said head and said shaft coaxial, an unbalanced weight rigidly attached to said shaft, and means for rotating said shaft.

30. In a crusher, a casing forming a crushing chamber, a crusher head within said chamber, a rotary shaft disposed centrally of said head, an unbalanced weight rigidly attached to said shaft, and direct connected driving means for rotating said shaft located above said suspension.

In testimony whereof, we have hereunto set our hands.

JACOB M. SHOLL.
ERNEST E. PFEFFER.