

Dec. 15, 1931.

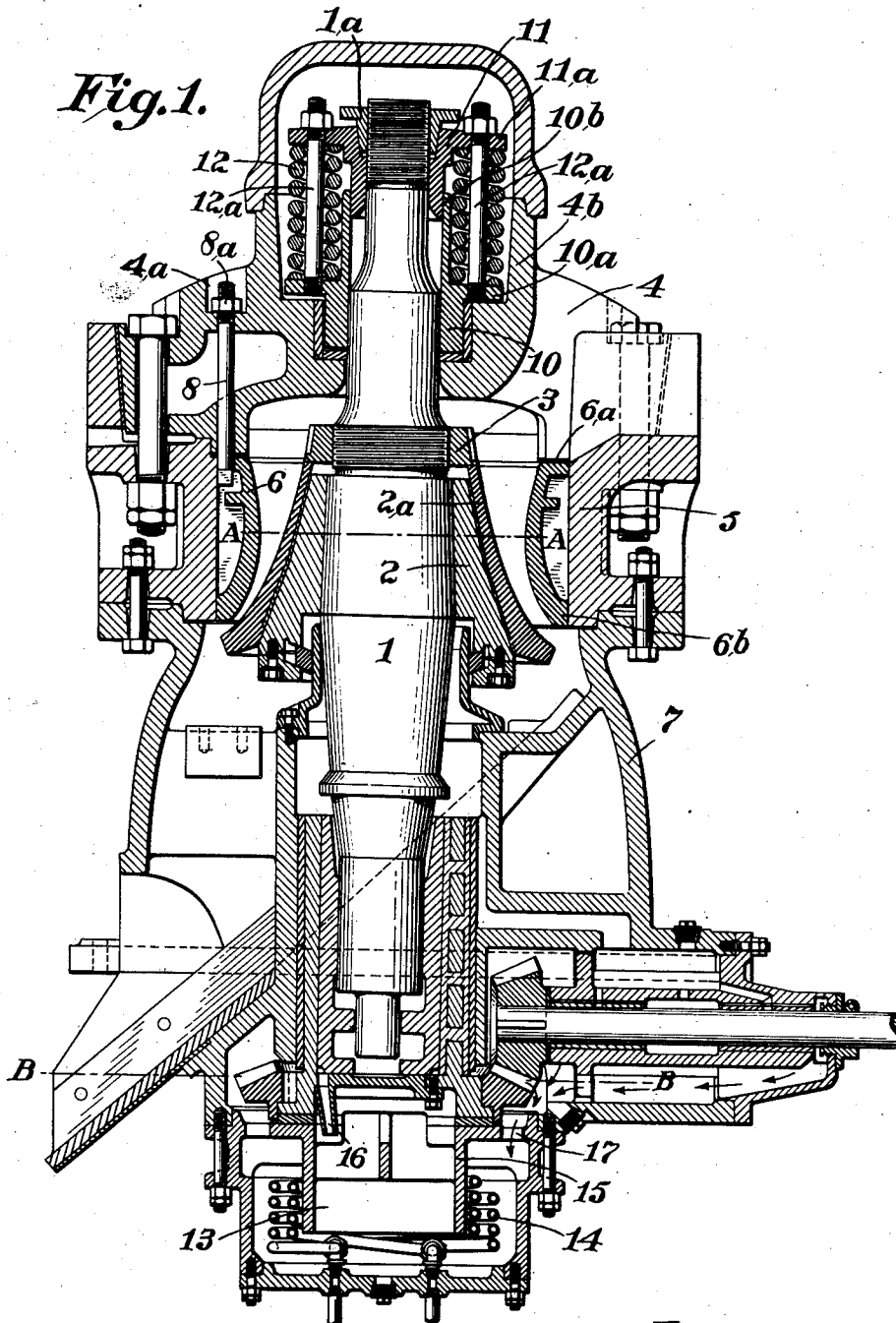
R. BERNHARD

1,837,102

GYRATORY CRUSHER

Filed Aug. 18, 1928

2 Sheets-Sheet 1



Inventor:

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2 Sheets-Sheet 2

Fig. 2.

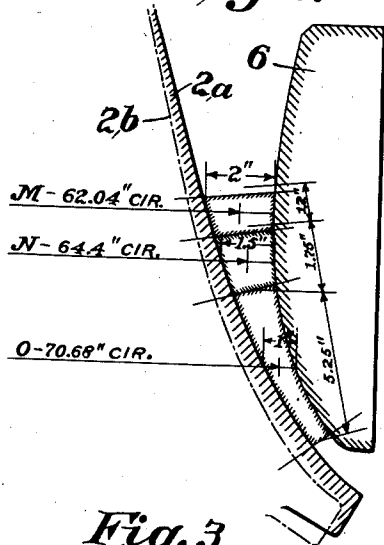


Fig. 6.

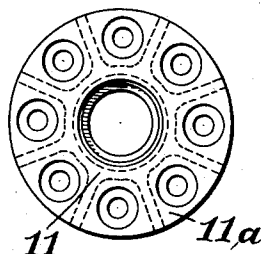


Fig. 7.

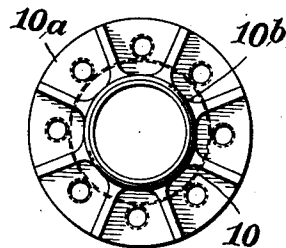


Fig. 6a.

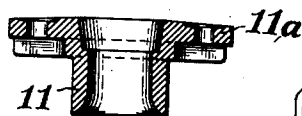


Fig. 7a.

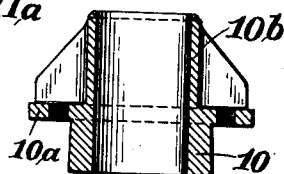


Fig. 3.

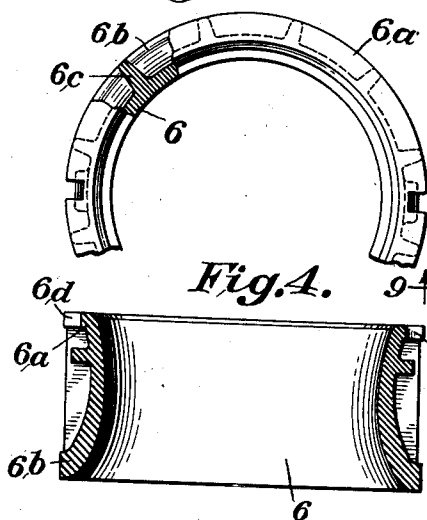


Fig. 8.

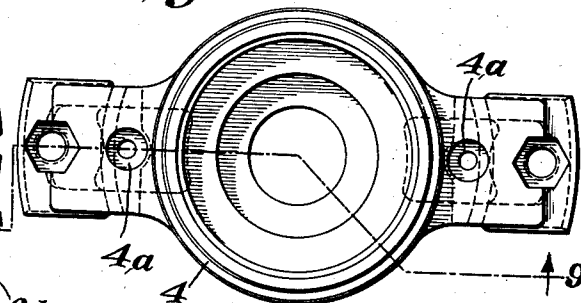


Fig. 9.

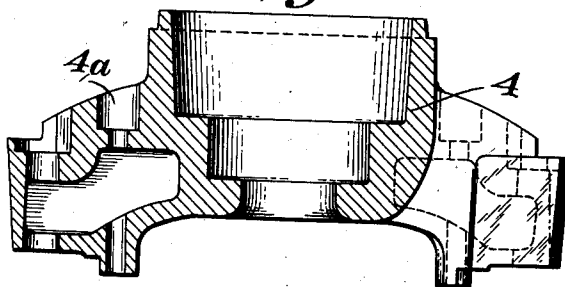
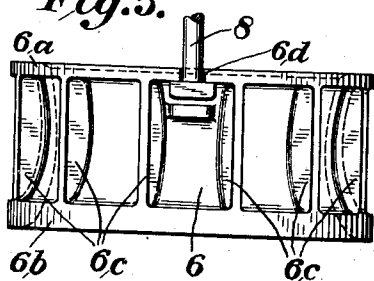


Fig. 5.



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UNITED STATES PATENT OFFICE

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GYRATORY CRUSHER

Application filed August 18, 1928. Serial No. 300,549.

My said invention relates to improvements in the type of crusher disclosed in Letters Patent of the United States granted to the Taylor Engineering and Manufacturing Company, as my assignee, on the 6th day of April, 1920, Number 1,336,015.

One of the objects of the invention is to provide a crusher in which the crushing space cannot possibly become choked by the descending crushed material.

Another object is to provide a simple, durable and efficient construction which will enable the gyratory crushing member to yield in case tramp iron or other uncrushable material enters the crushing space, thereby preventing danger of breakage of the machine.

A further object is to provide a crusher having simple and efficient means for effecting vertical adjustment of the concave and in which the concave will be amply sustained against crushing thrusts.

Another object is to provide a concave and mantle of such shape that as the grinding faces wear, adjustment may be made to compensate therefor, and the relation of the grinding faces maintained until the mantle and concave are completely worn out.

Other objects will appear from the following description.

With these various objects in view, the invention includes the novel features of construction and arrangement and combination of parts hereinafter described and defined by the appended claims.

What I at present consider the preferred embodiment of the invention is illustrated in the accompanying drawings, in which:

Figure 1 is a central vertical section through such a crusher.

Fig. 2 is a fragmentary diagrammatic detail on a larger scale.

Figs. 3, 4, and 5 are detail views of the concave.

Figs. 6, 6a, 7, and 7a are detail views of spring suspension parts, and

Figs. 8 and 9 are detail views of the spider.

Referring by reference characters to these drawings, the numeral 1 designates the shaft of the crusher which carries a core or mantle carrying member 2 provided with a crushing

bell shaped mantle 2a held in place thereon by a head nut 3 threaded on the shaft and bearing on the upper edge of the mantle which projects above the top of the core.

The shaft is suspended at its upper end, by means hereinafter more fully described, by the supporting spider 4, (such means permitting gyratory movement of the depending portion of the shaft), which spider rests on a top shell frame part 5 to which it is securely bolted, and which top shell has a cylindrical bore to receive the concave 6.

The top shell 5 in turn rests upon and is bolted to a bottom shell 7, which contains the discharge diaphragm and eccentric bearing. As the eccentric bearing, eccentric, and operating means therefor are substantially the same as shown and described in my aforesaid patent, detailed description thereof herein is deemed unnecessary.

In crushers as heretofore constructed operating with a hopper feed, due to the fact that the crushing space between the cone and concave converges downwardly and decreases in volumetric capacity at successively lower levels, there has been liability of this space becoming choked with crushed material. This objection I avoid by making the crushing mantle and concave of such shape that while there is a gradually decreasing width for the crushed material from the top downward, being widest at the top where the rock enters and narrowest at the discharge flange or skirt of the mantle, the volumetric capacity is greater at any successive level below the crushing point A—A.

To accomplish this, I use a bell shaped mantle and a curved concave having an outwardly flared upper part and a more sharply flaring lower part.

The curves of the mantle and concave are so designed that while, as above stated, the diametric distance between their faces gradually decreases in a downward direction, the volumetric area at successively lower levels gradually increases, due to the increasing circumferences of the mantle and concave by reason of the increasing distances from the axis of the shaft.

The surfaces of the mantle and concave

gradually increase as their lower ends are approached (or in other words, the radius of curvature for both bell mantle and concave gradually shortens at successively lower points), and the curve of the concave increases more or is curved on successively shorter radii than the mantle, the result of which is that the curves of mantle and concave become more nearly concentric as the bottom is neared, being nearly concentric at the bottom or delivery point.

By this construction, while the surfaces of mantle and concave gradually approach each other, to crush the descending ore to successively finer degrees, the volumetric capacity is greater on succeeding lower levels and choking of the mill is absolutely prevented as the ore at lower levels has an opportunity to spread out.

This will be clear from an analysis of Figure 2, which shows on a larger scale than Fig. 1, one side of the mantle and concave, the full line 2a showing the mantle surface at its point of nearest approach to the concave; i. e., at the termination of the crushing action and the dot and dash line 2b indicating the position of said surface at its furthest point of recession.

The line A—A indicates the approximate point of commencement of the crushing operation, the space between mantle and concave above this line serving as a sort of hopper.

To illustrate the action, I have indicated on the drawings three parallelograms designated M, N, and O respectively.

Assuming that the mantle is in the position shown in full lines and that a piece of rock is located and held by contact with mantle and concave at the top line of parallelogram (on line A—A) as the mantle makes half gyration and its surface recedes from line 2a to line 2b, this piece of rock will fall and be caught between the surface 2b of the mantle and surface of the concave at the lower line of the parallelogram M.

As the mantle in the next half gyration approaches the concave and its surface moves from position 2b to position 2a, the rock is crushed, and on the next recession the rock drops again, but this time to the bottom of the parallelogram N, the drop being for a greater distance, and upon next approach of mantle and concave, the rock is again crushed.

A similar operation takes place in the space defined by parallelogram O but here a still further drop takes place as indicated by the vertical length of the parallelogram.

The possible drop of the rock in half a gyration is the vertical dimension of the corresponding parallelogram, being determined by the distance a stone nipped at the upper side of the parallelogram will drop when the mantle moves to the other side of the crusher.

It will be seen that the drop in zone M is

relatively small due to the fact that at this point the curves of mantle and concave are at their greatest departure from a concentric relation.

In zone N there is a greater drop because the curves have at this point approached more to a concentric relation, and in zone O there is the greatest drop because here there is a still further approach to concentricity.

Due to this greater drop, an increased volumetric capacity is provided at successively lower levels and thereby choking with crushed material is absolutely prevented, the material being spread out due to the increased volumetric capacity, the capacity being greatest at the discharge point.

Such increase results from the relative curves above described and the increasing distance from the line of the fulcrum point of the shaft or axis of rotation.

It will be understood that the increased volumetric discharge capacity occurs on each half gyration of the crusher head, or in other words, on its movement from "closed" to "open" position, i. e., from point of nearest approach to the concave to point of maximum distance therefrom. This movement allows the material that has been pinched to fall and become lodged in a lower section of the crushing space, or, if fine enough, to be discharged from the crusher.

This will, possibly be made clearer by the following figures, in which the first figure of each series is the average horizontal width of the opening for the zone, the second figure the drop in inches, and the third, the circumference at the center of the zone, while the product is the volume in cubic inches per gyration.

Zone	Opening	Drop	Circum.	Capacity
M-----	2"	1.2"	62.04"	148.896 cu. in.
N-----	1.5"	1.75"	64.4"	169.05 cu. in.
O-----	1"	5.25"	70.68"	371.07 cu. in.

Thus, while the descending rock or ore is gradually crushed finer and finer, there cannot be any choke of crushed material because in descending it enters a space of larger volume and can spread out therein.

In further explanation of my invention, we may regard the parallelograms M, N, O, for examples, as zones. These are defined as to their upper and lower sides by radial dimensions extending transversely of the downwardly tapering space between the head and concave, the upper radial dimension of each zone in the closed position of the parts being of a length equal to that of the lower radial dimension in the open position of the parts. Each zone increases in volumetric capacity in respect to the next higher zone and as a result of this no choking of the apparatus will take place, but on the contrary, discharge of the

crushed material will occur in adequate volume to prevent any choking effect.

In addition to the curved face feature of the concave above described, I prefer to make it of substantially arch shape in cross section, terminating at top and bottom in annular flanges 6a and 6b which bear against the inner cylindrical wall of the shell part 5 and are slidable thereon.

The arch shape of the concave affords the requisite strength to withstand the crushing strain, but for added support, I provide the outer face of the concave with vertical ribs 6c which likewise bear against the inner wall of the shell.

The upper flange 6a is provided with recesses 6d on diametrically opposite sides, which are engaged by the T heads of bolts 8 which pass upward through openings in the arms of the spider and are provided at their upper ends with nuts 8a which are preferably seated in recesses or counter sinks 4a in the top walls of the spider arms.

Shims 9 are provided between the upper faces of the flanges 6a and the corresponding under faces of the spider member 4, the concave being drawn upward against these shims by the bolts 8.

By loosening the nuts and varying the shims, the concave may be adjusted vertically as desired, according to wear.

It will be seen that the entire thrust on the concave is taken up by the shims and spider, the bolts serving merely to prevent the concave from dropping.

In order to prevent breakage of the crusher in case tramp iron or other incrushable substance gets between the mantle and concave, I provide the following mechanism.

The spider bushing 46 is bored out around the shaft to provide an annular chamber having a stepped bottom in which is located a sleeve 10 forming a spring cage. Said sleeve has a horizontal annular flange 10a forming a spring seat and a relatively thin upstanding annular portion 10b which telescopically engages the cylindrical lower part of the suspension sleeve or member 11.

Said suspension sleeve has a horizontal annular flange 11a opposed to or overlying the flange 10a and between said flanges is located an annular series of springs 12. Bolts 12a have their lower ends tapped into the flange 10a and their upper ends slidably engaging openings in the flange 11a and are provided with nuts for tying the parts together and placing the requisite initial compression on the springs.

In case of entrance of an uncrushable article or substance, the springs will yield and allow the shaft and mantle to move downwardly, thus preventing breakage, the lower portion of the shaft being slidable in relation to the eccentric.

The sleeve 11 is slidably mounted relative

to the shaft and has a tapered countersunk portion which is engaged by tapered nut 1a engaging the threaded reduced upper end of the shaft 1.

By this means, I provide a yieldable mounting for the core and mantle which is also adjustable for varying the size of the discharge opening and to take up wear, and this in addition to the adjustment of the concave whereby a greater range of adjustment is provided.

By making the mantle of bell shape, i. e., having its crushing surface curving outwardly on gradually shortening radii, and the coacting portion of the mantle of similar curvature, both the mantle and concave in the discharge region will wear uniformly and during such wear will maintain substantially their original curvature. Thus no matter how much the wear, a simple adjustment of the parts relative to each other will enable the mill to deliver the desired size of product.

As these crushers run at relatively high speed and under great stress, I have found that the oil which circulates through the gear chamber and gearing tends to heat up. To obviate this, I provide the oil chamber 13 with a coil 14 connected to any suitable source of cold water (not shown). Preferably the coil is of annular form and within the same is placed a depending circular skirt or deflector 15.

It will be understood that normally the oil is maintained at approximately the level indicated by the dotted line B—B, is drawn from the oil chamber 13 or elevated by the scoop 16, and returns to chamber 13 from the gear casing by port or passage 17. The skirt or diaphragm 15 causes the returning oil to be deflected downwardly through and around the cooling coils before it can rise to and be picked up by the scoop.

While I have hereinbefore described and shown a crusher in which the crushing member is formed by an inner carrying member or core and an outer mantle, these in effect constitute the crushing cone, and it is immaterial so far as my invention is concerned whether the crushing member is of one piece or multiple piece construction.

It will be further understood that the same is true, in the broader aspects of my invention, concerning the concave, which may be of unitary or divided ring form.

Having thus described my invention, what I claim is:

1. In a gyratory crusher, a crushing head, a shell surrounding the same having a cylindrical inner wall and a ring concave having its outer and inner walls formed concavo-convex on vertical lines with the top and bottom portions of the concave engaging said cylindric wall.

2. A crusher according to claim 1, in which

the outer wall of the concave has vertical ribs also bearing against the cylindric wall of the shell.

3. In a gyratory crusher a concave, a crushing cone coacting therewith, a gyratory shaft carrying said cone, a spider having an opening to receive the upper end of said shaft, said opening being cored out to provide an annular recess with a stepped bottom a sleeve encircling the shaft within said recess having an annular flange forming a spring seat, a suspension nut fast on said shaft having a flange overlying said spring seat, a nest of compression springs between said flange and spring seat, and means for tying said flange and spring seat together, said spring seat sleeve having a reduced sleeve portion extending upward within the nest of springs and telescopically engaging the lower end of the suspension nut.

4. A gyratory crusher having a substantially concavely curved gyratory head, a concave having its inner face, which opposes the concavely curved face, formed on a convex curve, the space between said head and concave tapering downwardly, with the successive zones resulting from the gyratory movement of the head defined on the upper and lower sides by radial dimensions extending transversely of the said space, the upper radial dimension of each zone in the closed position of the parts being of a length equal to that of the lower radial dimension in the open position of the parts, each crushing zone in the lower part of the crusher increasing in volumetric capacity in respect to the next higher zone, substantially as described.

5. A gyratory crusher according to claim 4 in which the curves of the head and concave are formed on gradually shortening radii towards the discharge end of the apparatus.

6. A gyratory crusher according to claim 4 in which the curves of the head and concave approach more nearly to concentricity approaching the discharge outlet.

7. A gyratory crusher according to claim 4 in which the lower portion of the head curves outwardly and the concave has its lower portion curved outwardly and overlying said outwardly curved portion of the head.

8. A rock crusher of the type having a chamber, the opposing walls of which have relative movement towards and from each other and in which chamber the material has an intermittent descent from zone to zone due to the relative successive opening movements of the walls, the said chamber being tapered downwardly with the point of closest approach of its walls at the lower end thereof, said chamber having a feed controlling zone of minimum volumetric capacity located intermediate the height of the

chamber, and above the said point of closest approach of the chamber walls, the crushing zone or zones below said minimum zone being each defined by radial dimensions extending transversely of the said chamber, the upper radial dimension of each zone in the closed position of the parts being of a length equal to that of the lower radial dimension in the open position of the parts and each zone being of non-decreasing volumetric capacity in respect to the next higher zone to insure free delivery of the reduced material.

In testimony whereof, I affix my signature.
RICHARD BERNHARD.

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