

Sept. 16, 1930.

D. COLE

1,775,750

CRUSHER

Filed Sept. 24, 1928

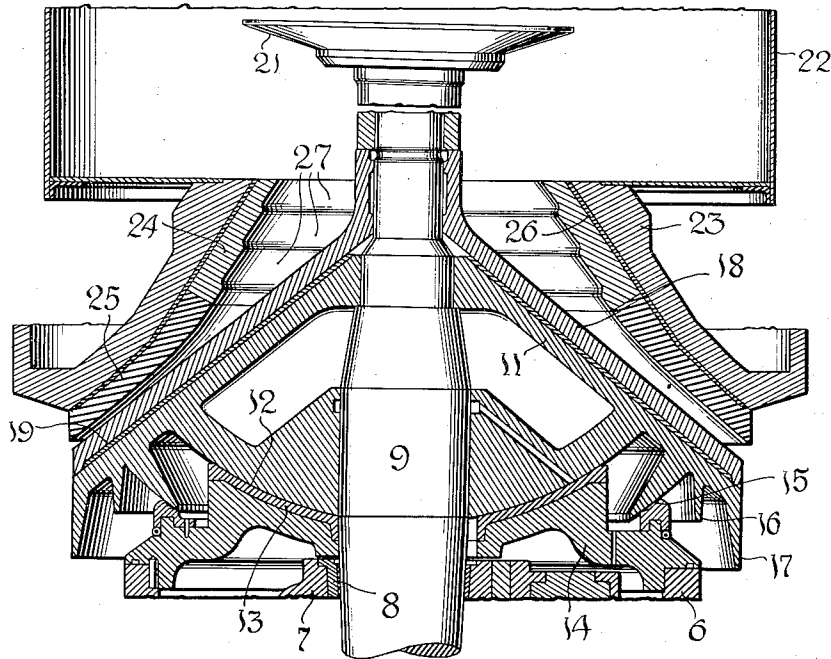


Fig. 1

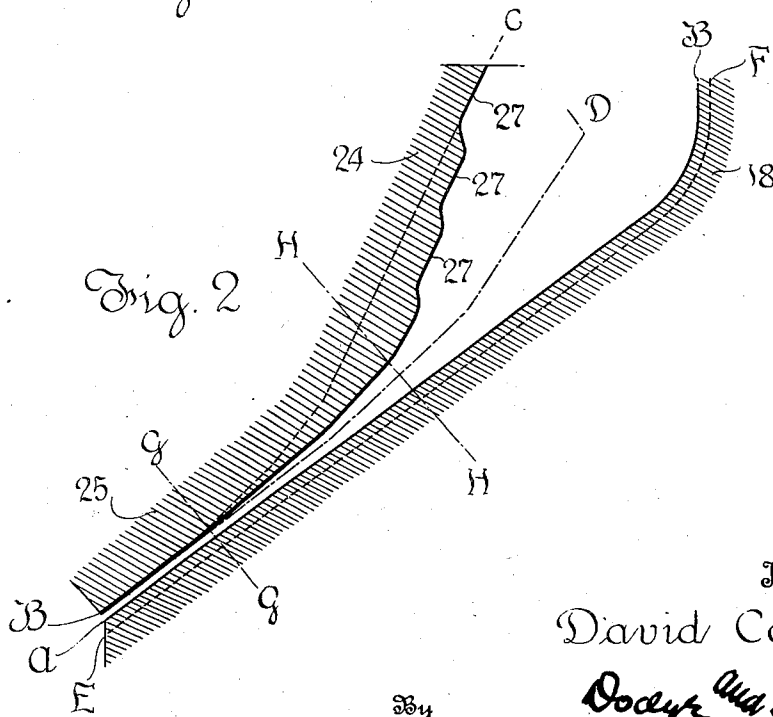


Fig. 2

Inventor

David Cole

Dodys & Am.

Attorneys

UNITED STATES PATENT OFFICE

DAVID COLE, OF EL PASO, TEXAS, ASSIGNOR TO NORDBERG MANUFACTURING CO., OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN

CRUSHER

Application filed September 24, 1928. Serial No. 307,968.

This invention relates to gyratory crushers and more particularly to gyratory crushers constructed in accordance with the disclosure of Patent 1,537,564, and operating according to the process claimed in Patent 1,537,565, both granted to Edgar B. Symons, May 12, 1925.

The invention will develop features of utility in connection with gyratory crushers generally, but is peculiarly valuable in connection with the Symons gyratory crusher because of certain limitations heretofore imposed on the design of that crusher by the requirements of the so-called "sizing zone".

A characteristic feature of the Symons process is the feed of the material to the crusher at a controlled rate such that the space between the cone and concave is never filled, the material flowing in a stream made up of substantially a single layer of particles. It follows that the materials undergoing crushing drop freely through the crushing zone and pass freely through by gravity, being periodically interrupted in their motion by a succession of crushing impacts.

In this process the pieces are successively crushed between the concave and the cone rather than being compacted and crushed against each other, and this has made it possible to provide between the lower margin of the cone and concave what Symons calls a zone of parallelism in which the opposed walls of the crushing element are approximately parallel at their position of maximum approach.

As stated in Symons specification, the length of the zone of parallelism is governed by two main factors, first, the speed imparted to the material by gravity, and, second, the interval of time between successive crushing impacts during which the material is permitted to drop as it is released by the increasing distance between the opposed cone and concave and during which it glides along the cone prior to the crushing nip. The interval of time is governed by the speed of operation of the machine. The length of the zone of parallelism must be such that all the material passing thereto will remain in the zone so long as to be caught at least once by

the cone and the concave at the moment of their closest approach.

This zone of parallelism with its sizing function is one of the most important and valuable features of the Symons process, but the necessity of providing such a zone of a given length has heretofore limited the degree of reduction which could be produced in a single crusher. Above the zone of parallelism, the walls of the cone and concave are sharply convergent forming what I shall call the reducing zone. There is a maximum permissible angle of convergence of the cone and concave which can not be exceeded, because if it is exceeded the material will be wedged back and not crushed. This limiting angle I shall call the maximum angle of nip. With the length of the reducing zone fixed and the maximum angle of nip fixed, the maximum entrance aperture for a cone of given size is necessarily limited if the cone and concave are designed in the conventional manner shown in the Symons patents and heretofore exclusively used in practice.

I overcome this difficulty by providing the reduction zone portion of one of the two crushing members, preferably the concave, with annular steps, each step offering a crushing surface whose angle does not exceed the maximum permissible angle of nip.

By adopting this arrangement it becomes possible to perform, in a single crusher, of a given size, the work that heretofore required the successive operation of two crushers of the same size, one designed to "take" a large piece and the other designed to "take" a much smaller piece and yield a much finer product.

The importance of using a single crusher will be appreciated when it is observed that the "size" of the feed is determined by the size of the maximum piece. In the case of a particular copper ore coming within my experience, the maximum size to be provided for in the crusher is fourteen inches, but this size comprises less than one per cent of the whole feed; and less than ten per cent of the whole feed exceeds two inches. The final size is one-fourth of an inch.

The use of a single crusher under these

circumstances reduces the plant investment by approximately one-half and reduces the power consumption by nearly a half, because the power applied in the two crushers formerly used is obviously not economically applied.

The invention will now be described in detail in connection with the accompanying drawing, in which,—

Fig. 1 is a vertical axial section of a portion of a Symons crusher such as is illustrated in the patents above mentioned, showing my invention applied.

Fig. 2 is an axial section through one side of my improved cone and concave shown in full lines, and with the outlines of a Symons coarse bowl crusher and a Symons fine bowl crusher heretofore used in sequence with each other, indicated in broken lines for purposes of comparison.

No effort is made to illustrate all the details of the crusher which may be identical with the present Symons standard practice and which is illustrated in more or less detail in the patents mentioned and in others granted to E. B. Symons.

6 represents a portion of the base frame of the machine and 7 represents a portion of the eccentric sleeve which has a bearing bushing 8 for the gyrating shaft 9, which carries near its upper end a cone 11.

The cone 11 has a lower spherical bearing surface 12 which coacts with a babbitted bearing 13, this bearing being sustained by a casting 14 which is supported on the bed frame 6.

A guard bearing 15, for preventing the escape of oil and for excluding dust, is used as in the Symons structure, and further protection against dust is afforded by the skirts 16 and 17.

18 is a conical mantle mounted on the crushing cone 11 and conforming to current standard practice, as exemplified in the Symons patents. It is mounted on a bed of zinc 19, in the usual manner.

The gyrating shaft 9 carries at its upper end the usual feeding disk 21 which is arranged to coact with the feed restricting chute, such as the part E²⁹ of Symons Patent 1,537,564. It is understood that the sleeve 7 will be rotated in any convenient manner, preferably that shown in the Symons patents, and that, generally, the structure will conform to the Symons practice.

22 is the feed hopper mounted on the conical spider 23, which may be adjustably mounted, as shown in Symons 1,537,565, or may be both yieldingly and adjustably mounted as shown, for example, in Symons 1,592,313, July 13, 1926.

Mounted within the spider 23 is a concave mantle preferably formed in two parts, 24 and 25, embedded on zinc 26, as is usual.

The lower section 25 includes the zone of parallelism and the lower portion of the re-

duction zone. The contour of the lower section follows known practice except that the upward divergence between the cone and the concave is somewhat more pronounced than in the case of a standard Symons crusher designed for fine crushing, and is less pronounced than in the Symons crusher designed for coarse crushing. The upper section 24 is provided with a plurality of annular crushing surfaces 27 arranged in stepped relation with each other and each at such an angle to the cone as is within the maximum permissible angle of nip. The effect is to increase the entrance aperture without correspondingly increasing the angle of nip.

Referring now to Fig. 2, the relation of my improved design to the standard Symons design can be readily appreciated. The full line A—B is the contour of the crushing cone and the full line B—C is the contour of the crushing concave according to the present invention. The dot and dash line B—D represents the contour of a standard Symons concave for fine crushing. Such a concave would be used with a cone having the contour A—B. In other words, it would be used with the same cone as is shown in the present application.

A coarse crusher of Symons design would have a concave contour conforming to the broken line B—C and a cone contour conforming to the broken line E—F. It will be observed that in my improved construction the zone of parallelism, whose upper limit is indicated by the line G—G is the same in my crusher as in the Symons fine crusher, and that the zone of reduction between the lines G—G and H—H is characterized by a divergence of the two surfaces greater than in the case of the Symons fine crusher and less than in the case of the Symons coarse crusher.

The initial reduction zone between the line H—H and the point of entrance of the material, has an effective rate of divergence greater than the divergence in either type of Symons crusher, but the angle of nip is the same as that in the coarse crusher because the steps 26 are either parallel or coincident with the broken line B—C which is the contour of the Symons coarse crusher cone. The effect is to get an entrance aperture as large as is secured in the Symons coarse crusher, a sizing zone or zone of parallelism the same as is secured in the Symons fine crusher, and an intervening zone of reduction which is entirely within the present working limits, because it falls between the standards of two commercial Symons crushers.

It may be stated that the broken line B—C, the dot and dash line B—D, and their relations to the lines A—B and E—F are taken directly from Symons Bros. catalogue and are therefore illustrative of present commercial practice.

Obviously other arrangements are possible within the scope of the inventive concept which contemplates the use of a series of annular steps on one of the crushing members, each step being at an angle within the limit of crushing nip, and the steps being so arranged as to increase the effective entrance aperture. As pointed out this avoids the limitation otherwise imposed on the entrance aperture by the length of the sizing zone and the limiting angle of nip.

While the invention derives peculiar value in connection with the Symons gyratory cone crusher, for the reason just mentioned, certain of the advantages of the invention can be secured in other gyratory cone crushers, and such use falls within the broad scope of the present invention.

Inasmuch as the stepped portion of the concave does less work than the lower portion, it needs to be replaced less often, and, consequently, it is advantageous to form the concave in two parts, the line of separation being near or slightly below the lower margin of the lowermost step.

What is claimed is:—

1. A crusher of the type including two opposed crushing elements movable relatively toward and from one another, with means for feeding material between said elements at a controlled rate such that the material flows in substantially a single layer of particles which are periodically arrested by crushing impacts delivered directly to the particles by both said members during their approach, said crusher being characterized by the fact that the entrance aperture exceeds that subtended by the maximum permissible angle of nip and that there is a reduction zone immediately beneath the entrance comprising a plurality of steps each having a crushing face within the limiting angle of nip.

2. A gyratory crusher having a cone and a surrounding concave, means for producing gyratory motion, and means for limiting the rate of feed to a value such that the material flows in substantially a single layer of particles which are periodically arrested by crushing impacts delivered directly to the particles by the cone and concave, said crusher being characterized by the fact that the annular entrance to the crushing zone exceeds that subtended by the maximum permissible angle of nip and that the concave adjacent said entrance is formed with a plurality of annular steps each having a crushing face within the limiting angle of the nip.

3. A gyratory crusher comprising a cone member and an encircling concave member, one of said members having its entrance portion formed with annular steps having faces within the limiting nip angle; and means for producing relative gyratory motion of said members.

4. A gyratory crusher comprising a cone

member and an encircling concave member, the concave member having its entrance portion formed with annular steps having faces within the limiting nip angle; and means for producing relative gyratory motion of said members.

5. A gyratory crusher comprising a cone member and an encircling concave member, one of said members having its entrance portion formed with annular steps having faces within the limiting nip angle, and the two members being formed to afford a zone of parallelism adjacent the discharge; and means for producing relative gyratory motion of said members.

6. A gyratory crusher comprising a cone member and an encircling concave member, the concave member having its entrance portion formed with annular steps having faces within the limiting nip angle, and the two members being formed to afford a zone of parallelism adjacent the discharge; and means for producing relative gyratory motion of said members.

7. A gyratory crusher comprising a cone member and an encircling concave member, one of said members having its entrance portion formed with annular steps having faces within the limiting nip angle; means for producing relative gyratory motion of said members; and means for feeding material to said crusher at a limited rate such that the interval between the cone and concave is never filled.

8. A gyratory crusher comprising a cone member and an encircling concave member, the concave member having its entrance portion formed with annular steps having faces within the limiting nip angle, and the two members being formed to afford a zone of parallelism adjacent the discharge; means for producing relative gyratory motion of said members; and means for feeding material to said crusher at a limited rate such that the interval between the cone and concave is never filled.

9. A crusher of the type defined in claim 4, characterized by the fact that the upper annularly stepped portion of the concave is made in a separate piece from the lower portion of the concave.

10. A gyratory crusher comprising a cone member and an encircling concave member, the concave member overlying the cone member, the lower portion of the concave member approaching relatively closely to the cone member, an upper portion of the concave member being substantially flared away from the opposed face of the cone member, the flared-away portion of the concave member being formed with irregularities of surface adapted to reduce lateral movement, in relation to such surface, of particles gripped between it and the opposed portion of the cone.

11. A lining for the bowls of gyratory

crushers, said lining having an annular conoidal internal surface whose elements are irregular lines, which lines, proceeding from the larger toward the smaller diameter, present an angle with the axis of the conoid which diminishes until a minimum value is approached, and thereafter are offset away from said axis in steps, each of which approximates said minimum angle.

12. A lining for the bowls of gyratory crushers, said lining having an annular conoidal internal surface whose elements are irregular lines, which lines, proceeding from the larger to the smaller diameter, are first substantially straight, then curve outward to present a diminishing angle with the axis of the conoid until a minimum angle is attained, and thereafter are offset to present steps, each of which approximates said minimum angle.

13. A lining for the bowls of gyratory crushers, said lining having an annular conoidal internal surface whose elements are irregular lines, which lines, proceeding from the larger toward the smaller diameter, present an angle with the axis of the conoid which diminishes gradually to a limiting value, to produce entrance flare, and then become sinuous and more flaring.

14. A lining as defined in claim 13 formed in two parts, one of which includes the entire sinuous portions of the elements.

15. A gyratory crusher comprising a cone member and an overlying encircling concave member, said members being formed to afford an annular entrance with a progressively increasing flare in a direction opposed to the direction of infeed, said flare attaining a value exceeding that afforded by the maximum permissible angle of nip and the surface of one of said members in the region of such excessive flare having ribs transverse to the direction of infeed; and means for producing relative gyratory motion of said members.

In testimony whereof I have signed my name to this specification.

DAVID COLE.

50

55

60