F. M. ILER.

DISK PULVERIZER.

APPLICATION FILED DEC. 3, 1910.

1,037,772.

Patented Sept. 3, 1912.

4 SHEETS—SHEET 1.

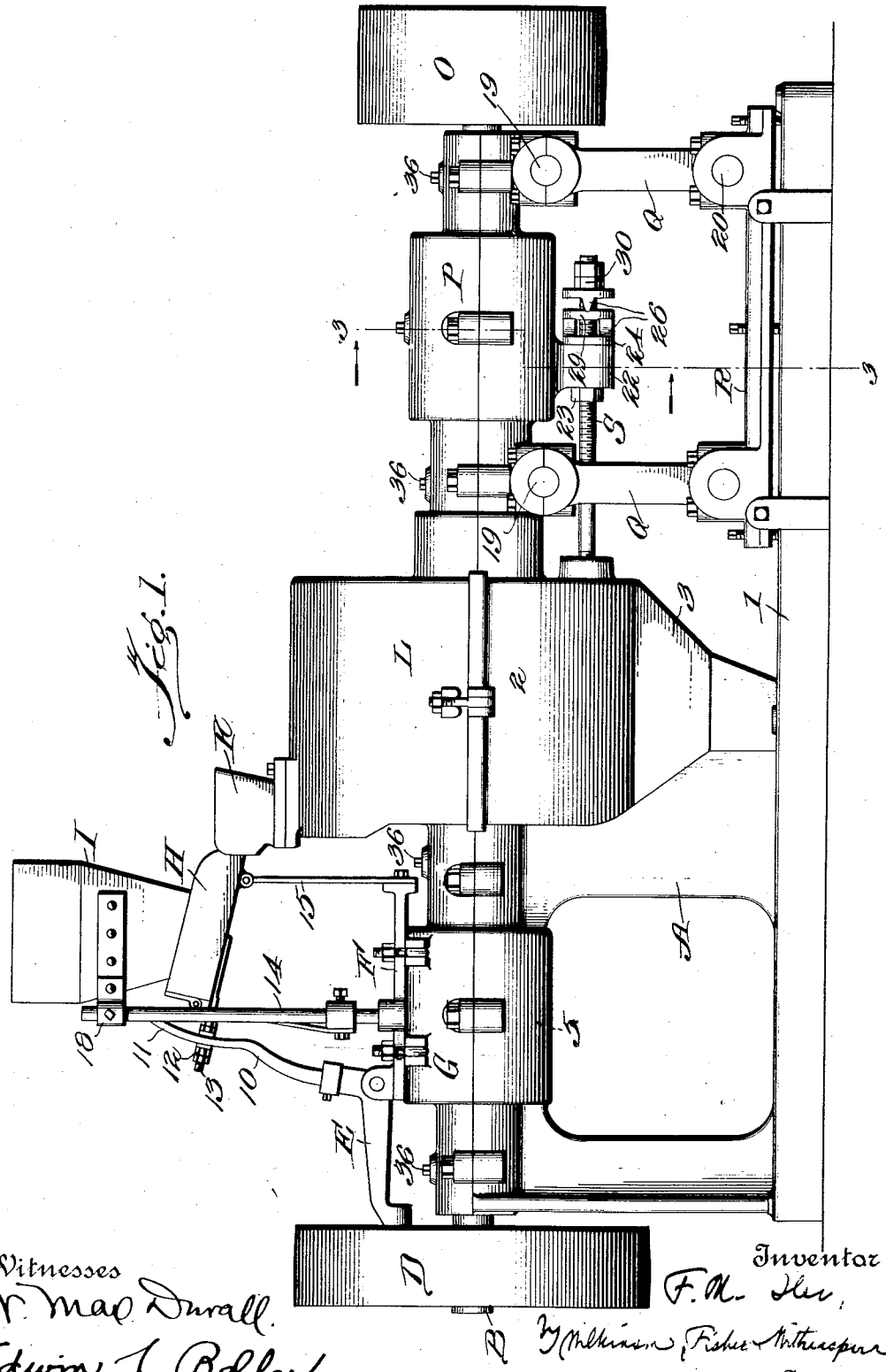

Fig. 1.

Witnesses

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4 SHEETS—SHEET 2.

Fig. 2.

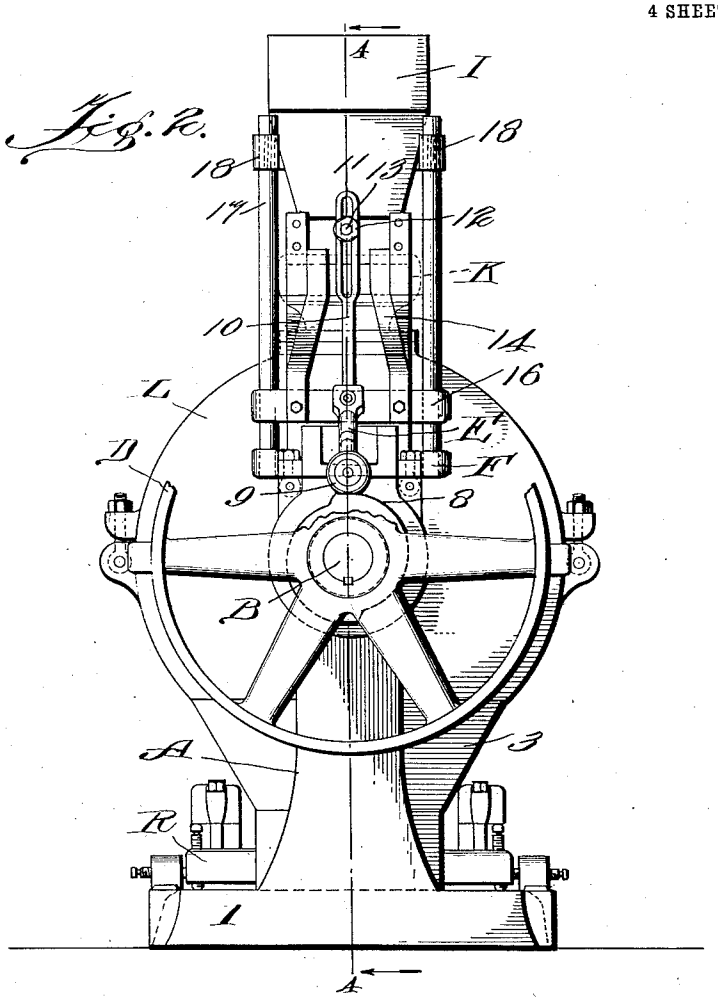
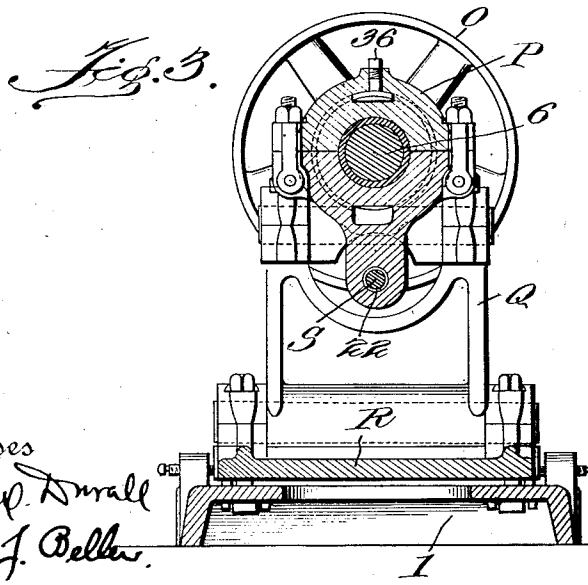


Fig. 3.



Witnesses

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4 SHEETS—SHEET 3.

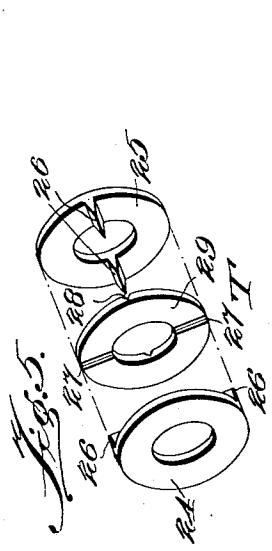

Fig. 5.

Fig. 4.

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4 SHEETS—SHEET 4.

Fig. 6.

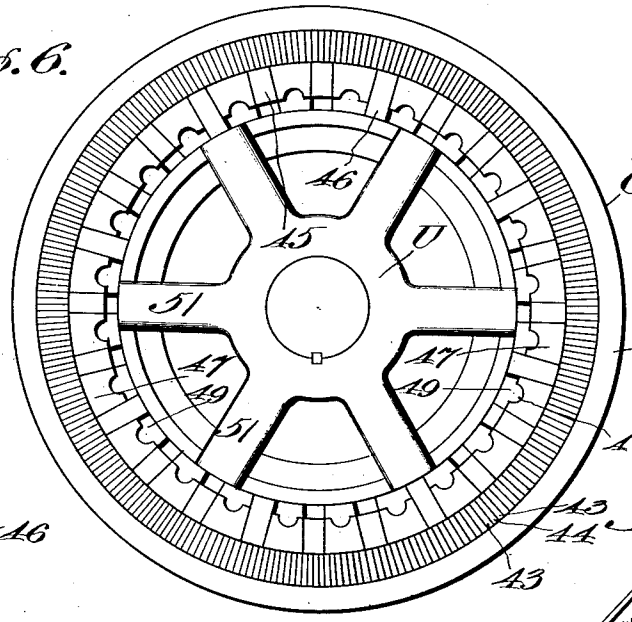


Fig. 8.

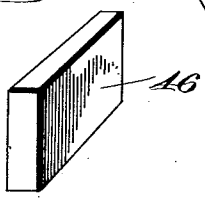


Fig. 11.

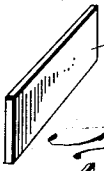


Fig. 9.

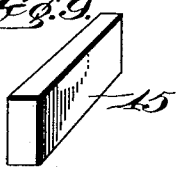


Fig. 10.

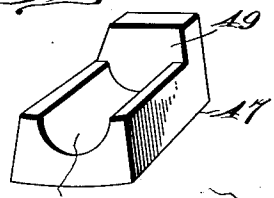


Fig. 12.

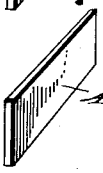
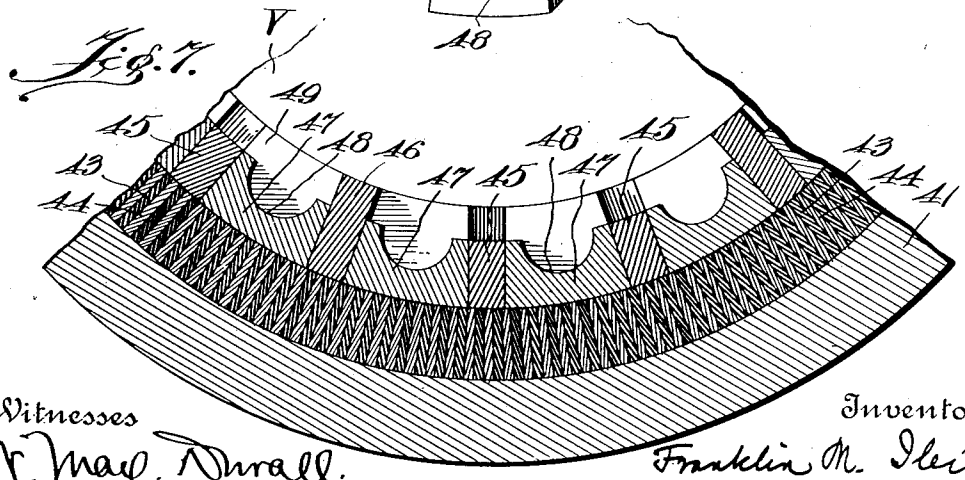


Fig. 7.



Witnesses

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UNITED STATES PATENT OFFICE.

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DISK PULVERIZER.

1,037,772. Specification of Letters Patent. Patented Sept. 3, 1912.

Application filed December 3, 1910. Serial No. 595,516.

To all whom it may concern:

Be it known that I, FRANKLIN M. ILER, a citizen of the United States, residing at Denver, in the county of Denver and State of Colorado, have invented certain new and useful Improvements in Disk Pulverizers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My present invention relates to improvements in disk pulverizers, and it is intended to provide an apparatus in which ore, or any other granular material, may be ground to any desired degree of fineness.

My invention will be understood by reference to the accompanying drawings, in which the same parts are indicated by the same letters throughout the several views.

Figure 1 is a side elevation of the complete apparatus. Fig. 2 shows an end view as seen from the left of Figs. 1 and 4, parts being broken away. Fig. 3 shows a section taken along the line 3—3 of Fig. 1. Fig. 4 shows a central vertical longitudinal section through the device along the line 4—4 of Fig. 2. Fig. 5 is a detail showing the means for relieving the apparatus under excessive strains. Fig. 6 is a detail showing the face of one of the pulverizing disks, as seen from the section line 6—6 of Fig. 4 and looking in the direction of the arrows. Fig. 7 is a fragmental sectional view through the other pulverizing disks, along the line 7—7 of Fig. 4, the parts being shown on a larger scale than in the other figures. Fig. 8 is a detail showing one of the inner crushing blocks. Fig. 9 shows one of the narrower crushing blocks. Fig. 10 shows one of the grooved spacing blocks. Fig. 11 shows one of the outer grinding blocks; and Fig. 12 shows one of the softer fillers between the outer grinding blocks.

A represents the main framework of the machine which may be made of a single casting, having the bed plate 1, provided with the chamber 2 to which the material to be ground is fed, said chamber having an inclined bottom 3, and an outlet 4. The casting is also provided with a chamber 5 for the end thrust bearing on the shaft B. This shaft B carries the pulverizing disk C, and is provided with a series of stepped shoulders 6, engaging the end thrust bearings 7 inclosed in the chamber 5. The outer end of the shaft B carries the drive pulley D provided with the cam plate 8 which engages the roller 9 at the end of the bell crank E. This bell crank is pivoted to the plate F which is mounted above the cover G. The upper arm 10 of the bell crank lever is slotted as at 11 to engage between the nuts 12 on the screw bolt 13 which is fastened to the bottom of the reciprocating chute H. This chute is supported by resilient rods 14 and 15, the rod 14 being connected to a yoke 16 sliding on the stanchions 17, while the rod 15 is connected to the plate F. I represents the hopper which is adjustably secured to the stanchions 17 by means of the yoke 18. The apparatus may be set to vary the feed as desired, by altering the tilt of the chute H and raising or lowering the hopper I. The material is fed from the chute through the funnel K having the throat K′ opening into the interior chamber of the disk C.

L represents the hood mounted over the chamber 3 and inclosing the upper portion of the pulverizing disks C and M. The details of construction of these disks C and M will be hereinafter more fully described.

The disk M is mounted on the shaft N which is provided with a series of stepped shoulders 6 engaging the end thrust bearings 7, similar to those already described in connection with the shaft B. These end thrust bearings are mounted in the chamber 5ª in the housing P which consists of two portions secured together as shown in Fig. 1. The shaft N is driven by the pulley O and the angular velocity of the shaft is preferably greater than that of the shaft B, for reasons which will be hereinafter stated.

The housing P is mounted on the links Q so as to have a slight longitudinal play, these links being pivoted to the housing as at 19 and to the base plate R as at 20, the latter plate being adjustable, relative to the bed plate 1 to which it is attached. The housing P is adjustably connected to the main frame A by means of the heavy screw S which engages in the screw threads 21 in the main frame and passes through the lug 22 on the housing P, which lug is held between the lock nut 23 and the frangible, relieving device T. The latter consists of three

washers mounted on the screw S, as shown in Fig. 4, details of which washers are shown more clearly in Fig. 5.

24 and 25 represent two end washers each having dull knife edges 26 adapted to engage in corresponding grooves 27 and 28 in the plain washer 29. Lock nuts 30 hold the end washer 25 in place. It will be noted that the thrust on the shaft N is taken up by the bolt S, and when this thrust becomes excessive, the knife edges 26 will rupture the washer 29, allowing the housing P and with it, the shaft N and disk M, to slide backward a small distance. The link connection permits this backward and downward movement of the said shaft N and housing P, and it is preferable to a straight sliding movement for the reason that apparatus of this character is apt to get clogged up with rust, or dirt, or other foreign matter, and to stick when the critical moment arrives, thus preventing the proper action of any automatic relieving attachments.

The chambers 5 and 5ª are partly filled with oil through suitable oil inlets 31. The surplus oil is carried away from the chamber 5 through passages 32 and 33. It is especially desirable to prevent oil from getting into the ground products in the chamber 2, and for this reason the oil from the chamber 5 is carried off through the passage 33, and the oil from the chamber 5ª that creeps under the shaft N toward the said chamber 2, falls into the annular trough 34 in the housing P, and escapes through an opening 35. (See Fig. 4) Oil ducts 36 may also be provided wherever desired.

The details of construction of the pulverized disks are shown in Fig. 4 and in Figs. 6 to 12, which will now be described. The grinding portions of the two disks C and M are substantially identical in construction, except that the two disks are preferably of unequal length axially for reasons hereinafter to be explained. Each disk comprises an outer ring 41 having a radial flange 42 inside of which ring, and bearing endwise against said flange, is a series of wedge shaped blocks 43 and 44 made of soft and hard metal, such as soft iron and hard steel, alternately disposed. Inside of this circle of alternating hard and soft blocks, is another circle of blocks 45 and 46, separated by spacers 47, said spacers being provided with grooves 48 and end lugs 49, and being wedge shaped, as shown in Figs. 7 and 10. The blocks 45 are not as long axially as the blocks 46, and thus between the blocks 46 there is a series of irregular pockets formed, as shown most clearly in Fig. 7.

The grinding faces of the two disks C and M are substantially identical, except that the pockets in one disk are, of course, deeper than those in the other. The disks are adapted to be attached either to the spider U shown in Figs. 4 and 6, or to the disk V shown in Figs. 4 and 7. This may be conveniently done by means of tap bolts 50. (See Fig. 4) The disk V being imperforate, forms an end closure for the central chamber in the disk M, while the spider U with its curved spokes 51 permits the material to be ground to pass into the chamber in the disk C, between said spokes, and to be thrown outward by centrifugal action into the pockets on the inner periphery of the two pulverizing disks. The abutting faces of these two disks are preferably set to the desired distance apart, which would ordinarily be extremely small.

In order to prevent circular scoring in the face of either disk, the axes of the shafts B and N are preferably eccentric. The two shafts are preferably caused to rotate in the same direction, the shaft N at a much higher rate of speed than the shaft B, so that the centrifugal motion will always keep the matter to be ground thrown outward, while the one disk passing over the other and in the same direction, would have a shearing effect, the large particles being broken up in the pockets by the crushing blocks 46, and the smaller particles passing into the narrow space between the two disks will be ground by the hard pulverizing blocks 43. The soft blocks 44 will wear away faster than the hard blocks causing little pockets to form between the hard blocks into which pockets the larger particles of dust pass and are ground under the grinding action of the two disks.

The operation of the device is as follows:—The material to be ground being in the hopper I, the parts being in the position shown in Fig. 4 and the shafts B and N being in rotation, the cam plate 8 will rock the bell crank lever E vibrating the chute H and shaking the material into the funnel K, whence it will pass through the throat K′ and into the chamber of the disk C, passing between the spokes in said chamber. The material will also enter the chamber of the disk M. The large particles will be crushed up in the pockets between the crushing blocks 46, and the finer particles will be thrown, by centrifugal force and also by gravity, into the space between the two disks, and will drop down into the outlet 4, to be thence carried away in any convenient manner. If any foreign matter such as a nail, spike, or the like should get into the space between the rapidly rotating disks and tend to do serious injury to the machine, the thrust backward on the shaft N will cause the knife edges 26 to break the washer 29, and thus give immediate relief to the apparatus, for the cause of the injury would be so small that it would drop through the enlarged aperture between the disks; or the charge, then in the appa-

ratus, and might be coarsely ground without injury to the apparatus, and the objectionable article discovered in the dump and removed. Then a new washer 29 could be put in place and the apparatus adjusted as before.

The disks C and M are preferably made of different axial lengths for the following reasons:—Suppose the blocks 46 in the disk C to be three inches in axial length, and the similar blocks in the disk M to be five inches in axial length, and assume that the blocks must be at least one inch long to be efficient. The grinding faces will wear at substantially the same rate of speed, and in due course of time one of the disks will have ground down to the effective length of one inch, and the other disk to the effective length of three inches. The apparatus, of course, is to be set up from time to time to compensate for this wear. Now, when these disks have ground down as stated, it will be a simple matter to take off and throw away the thin disk or stump and to shift the thick disk from the support V to the spider U, and then put on a new disk having an effective length of five inches, attached to the support V. In this way, eighty per cent. of the effective wearing surface of the manufactured disks may be used up and far greater economy may be secured than if each disk were originally made of the same axial length. It will be noted that the space between the crushing surfaces is constantly changing, causing a squeezing and crushing effect instead of solely a rubbing and grinding effect, thereby reducing the material to the desired size without crushing a great portion to a much less or undesirable size.

Another advantage is that in a machine of this character, any desired maximum size of the resulting particles may be produced without the use of screens. In practice, I prefer to run the slow speed disk at just about sufficient velocity to throw the particles outward and upward against the action of gravity, and I have found that about one hundred and thirty revolutions per minute are about sufficient for this purpose. The high speed crushing disk is preferably run at a much higher velocity. I have found in practice six hundred and thirty revolutions per minute to be satisfactory. This gives a crushing speed of five hundred revolutions per minute, and with this arrangement of speeds of the two disks, the force of gravity is never sufficient to cause the ore or other material being crushed, to run to the center of the disk or to fall back into the machine.

It will be obvious that other automatic speed attachments may be provided if desired and that other means for feeding the apparatus may be provided; also that various modifications might be made in the hereinafter described arrangement and combination of parts, which can be used without departing from the spirit of my invention. Thus for instance, the two disks may be run in opposite directions, instead of in the same direction. The grinding blocks 47 should preferably be of harder material than the wedge shaped spacing blocks 46.

Having thus described my invention, what I claim and desire to secure by Letters Patent of the United States is:

1. In an apparatus of the character described, the combination with oppositely disposed annular rotary disks, each disk being provided with a flanged ring, a series of pulverizer blocks mounted radially inside said ring, and a series of grinding blocks mounted inside of said pulverizing blocks, with chambered spacing blocks separating said grinding blocks, the whole forming a centrally chambered disk, with means for holding the faces of said disks in juxtaposition, and means for driving said disks, substantially as described.

2. In an apparatus of the character described, the combination with oppositely disposed annular rotary disks, each disk being provided with a flanged ring, a series of pulverizer blocks of alternately hard and soft metal mounted radially inside said ring, and a series of grinding blocks mounted inside of said pulverizing blocks, with chambered spacing blocks separating said grinding blocks, the whole forming a centrally chambered disk, with means for holding the faces of said disks in juxtaposition, and means for driving said disks, in the same direction and at varying speeds, substantially as described.

3. In an apparatus of the character described, the combination with oppositely disposed annular rotary disks, each disk being provided with a flanged ring, a series of pulverizer blocks mounted radially inside of said ring, and a series of grinding blocks mounted inside of said pulverizing blocks, said grinding blocks being of unequal radial length, with chambered spacing blocks separating said grinding blocks, the whole forming a centrally chambered disk, means for holding the faces of said disks in juxtaposition, and means for driving said disks, substantially as described.

4. In an apparatus of the character described, the combination with oppositely disposed annular rotary disks, each disk being provided with a flanged ring, a series of pulverizer blocks of alternately hard and soft metal mounted radially inside said ring, and a series of grinding blocks mounted inside radially of said pulverizing blocks, said grinding blocks being of unequal radial length, with chambered spacing blocks sep-

arating said grinding blocks, the whole forming a centrally chambered disk, means for holding the faces of said disks in juxtaposition, and means for driving said disks in the same direction and at unequal speeds, substantially as described.

5. In an apparatus of the character described, the combination with oppositely disposed annular rotary disks, each disk being provided with a flanged ring, a series of pulverizer blocks of alternately hard and soft metal mounted radially inside said ring, and a series of grinding blocks of unequal radial length mounted inside of said pulverizing blocks with wedge-shaped spacing blocks having end lugs and grooves separating said grinding blocks the whole forming a centrally chambered disk, with means for holding the faces of said disks in juxtaposition, and means for driving said disks in the same direction and at different speeds, substantially as described.

6. An apparatus of the character described, comprising a main frame, and two oppositely disposed, annular, rotary disks mounted thereon, means for feeding the material to be ground to said disks, means for holding said disks in juxtaposition, comprising a housing, links supporting said housing, a screw bolt connecting said main frame and said housing, a shaft for one of said disks journaled in said housing, and means for releasing said housing and allowing it to swing backward on said links, when the pressure becomes excessive, said means comprising a frangible washer mounted on said screw bolt and other washers, having knife edges located on each side of the first mentioned washer and adapted to break same when the pressure becomes excessive, substantially as described.

7. An apparatus of the character described, comprising a main frame, and two oppositely disposed, annular, rotary disks mounted thereon, means for feeding the material to be ground to said disks, means for holding said disks in juxtaposition, comprising a housing, links supporting said housing, a screw bolt connecting said main frame and said housing, a shaft for one of said disks journaled in said housing, and means for releasing said housing and allowing it to swing backward on said links, when the pressure becomes excessive, substantially as described.

8. In an apparatus of the character described, the combination comprising oppositely disposed annular rotary disks, forming together a central grinding chamber, each disk being provided with a flanged ring, a series of pulverizer blocks mounted radially inside said ring, and a series of grinding blocks mounted inside of said pulverizing blocks, with chambered spacing blocks separating said grinding blocks, substantially as described.

9. In an apparatus of the character described, the combination comprising oppositely disposed annular rotary disks, forming together a central grinding chamber each disk being provided with a flanged ring, a series of pulverizer blocks of alternately hard and soft metal mounted radially inside said ring, and a series of grinding blocks mounted inside of said pulverizing blocks, with chambered spacing blocks separating said grinding blocks, substantially as described.

10. In an apparatus of the character described, the combination comprising oppositely disposed annular rotary disks, forming together a central grinding chamber, each disk being provided with a flanged ring, a series of pulverizer blocks mounted radially inside of said ring, and a series of grinding blocks mounted inside of said pulverizing blocks, said grinding blocks being of unequal radial length, with chambered spacing blocks separating said grinding blocks, substantially as described.

11. In an apparatus of the character described, the combination comprising oppositely disposed annular rotary disks, forming together a central grinding chamber each disk being provided with a flanged ring, a series of pulverizer blocks of alternately hard and soft metal mounted radially inside said ring, and a series of grinding blocks mounted inside radially of said pulverizing blocks, said grinding blocks being of unequal radial length, with chambered spacing blocks separating said grinding blocks, substantially as described.

12. In an apparatus of the character described, the combination comprising oppositely disposed annular rotary disks, forming together a central grinding chamber each disk being provided with a flanged ring, a series of pulverizer blocks of alternately hard and soft metal mounted radially inside said ring, and a series of grinding blocks of unequal radial length mounted inside of said pulverizing blocks with wedge-shaped spacing blocks having end lugs and grooves separating said grinding blocks, substantially as described.

13. In an apparatus of the character described, the combination of rotary grinding disks forming together a central grinding chamber and comprising flanged rings, an outer annular series of alternately hard and soft pulverizing blocks mounted radially within each ring, and an annular series of crushing blocks and grooved spacing blocks mounted within said series of pulverizing blocks, said spacing blocks having a less radial dimension than said crushing blocks to provide arc-shaped, grooved pockets be-

tween the latter, and means for feeding material to said grinding disks.

14. In an apparatus of the character described, the combination of rotary grinding disks comprising flanged rings, an outer annular series of alternately hard and soft pulverizing blocks mounted radially within each ring, an annular series of crushing blocks and grooved spacing blocks mounted within said series of pulverizing blocks, said spacing blocks having a less radial dimension than said crushing blocks to provide arc-shaped, grooved pockets between the latter, end flanges extending radially from said spacing blocks flush with the inner faces of said crushing blocks, and means for feeding material to said grinding disks.

15. In an apparatus of the character described, the combination of rotary grinding disks comprising flanged rings, an outer annular series of alternately hard and soft pulverizing blocks mounted radially within each ring, and an annular series of crushing blocks and grooved spacing blocks mounted within said series of pulverizing blocks, said spacing blocks having a less radial dimension than said crushing blocks to provide an inner peripheral series of arc-shaped, grooved pockets between the latter, and means for feeding material axially within said peripheral series of pockets.

16. In an apparatus of the character described, the combination of rotary grinding disks forming together a central grinding chamber and comprising flanged rings, an outer annular series of alternately hard and soft pulverizing blocks mounted radially within each ring, and an annular series of crushing blocks and grooved spacing blocks mounted within said series of pulverizing blocks, said spacing blocks having a less radial dimension than said crushing blocks to provide an inner peripheral series of arc-shaped, grooved pockets between the latter, means for feeding material axially within said peripheral series of pockets, and means for rotating said grinding disks in the same direction at different speeds.

17. In an apparatus of the character described, the combination of rotary grinding disks, a bolt for holding said disks in coöperative relation, and a series of spaced washers provided with interengaging reduced bearing-surfaces slidably confined on said bolt.

18. In an apparatus of the character described, the combination of rotary grinding disks, an adjustably mounted step bearing for one of said disks, a bolt, a medial disk slidably mounted on said bolt and provided with perpendicular radial grooves on its respective faces, a pair of end disks slidably mounted on said bolt and provided with bearing surfaces for engaging such grooves, and a nut threaded on said bolt for confining said engaged series of disks against said step bearing.

In testimony whereof, I affix my signature, in presence of two witnesses.

FRANKLIN M. ILER.

Witnesses:
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C. C. LEMM.