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T. C. CADWGAN.

CRUSHING AND GRINDING MILL.

No. 421,481. Patented Feb. 18, 1890.

Fig. 1.

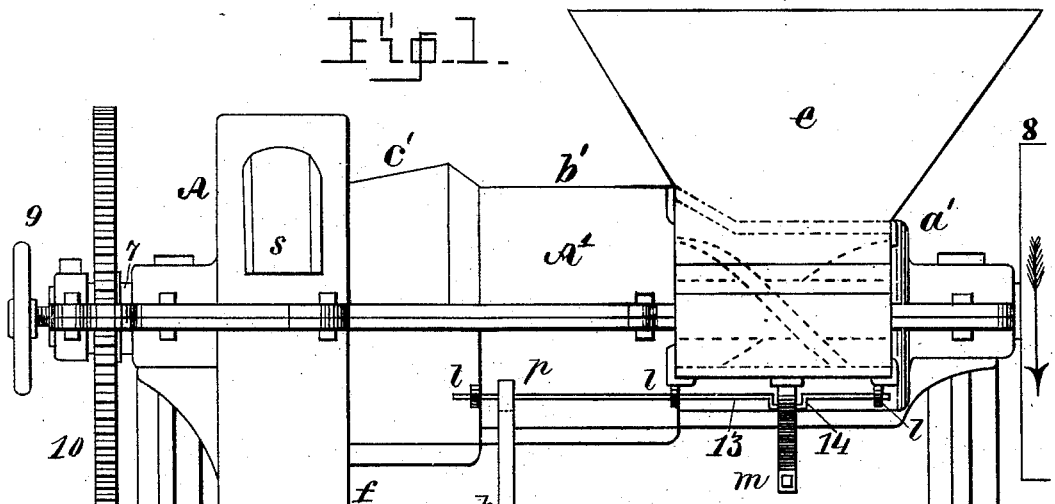

Fig. 2.

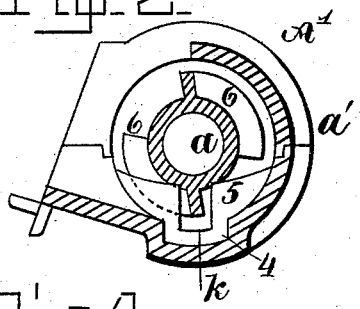

Fig. 3.

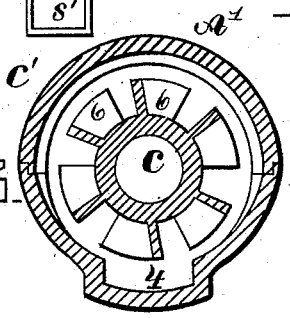

Fig. 4.

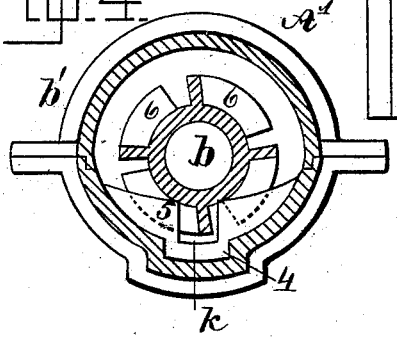

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Fig. 5.

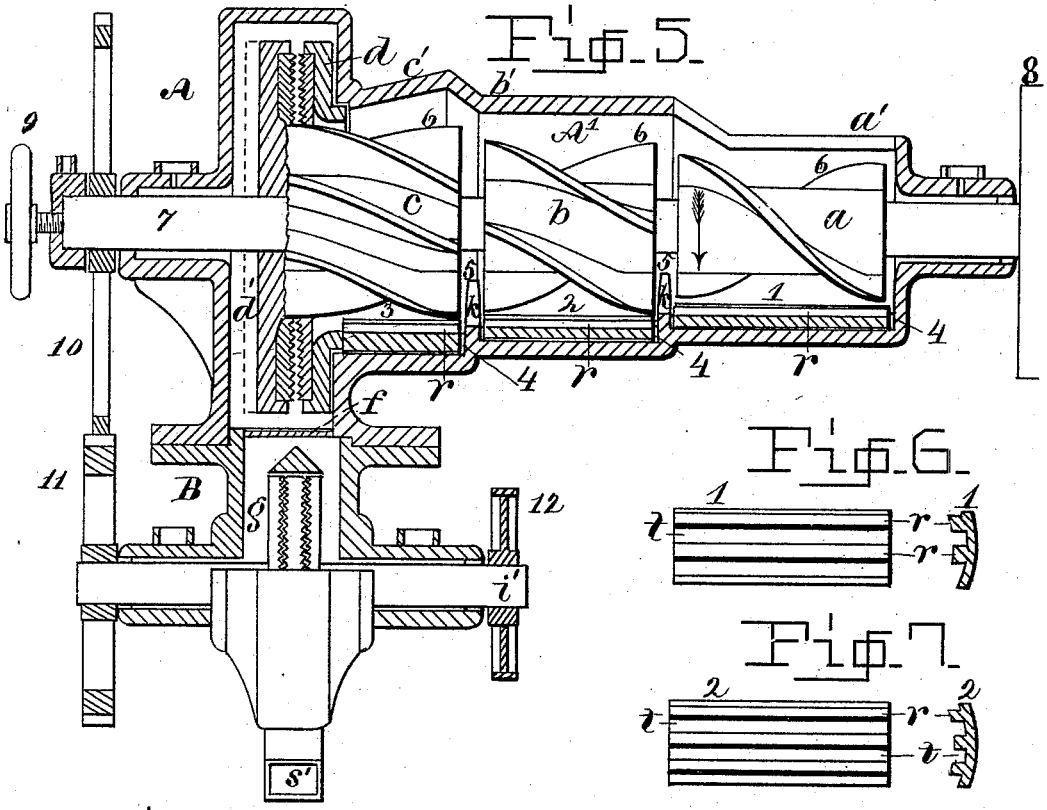

Fig. 6.

Fig. 7.

Fig. 9.

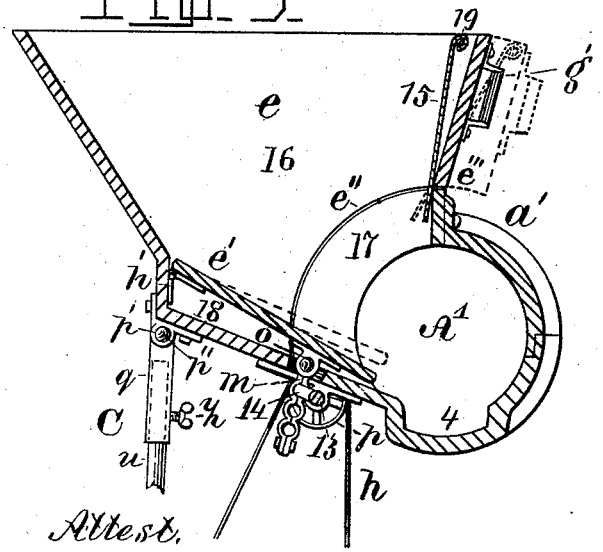

Fig. 8.

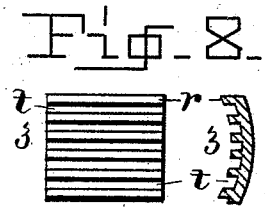

Fig. 8*.

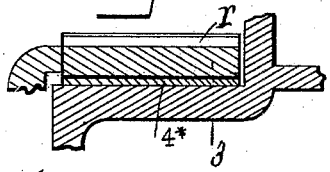

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Fig. 10.

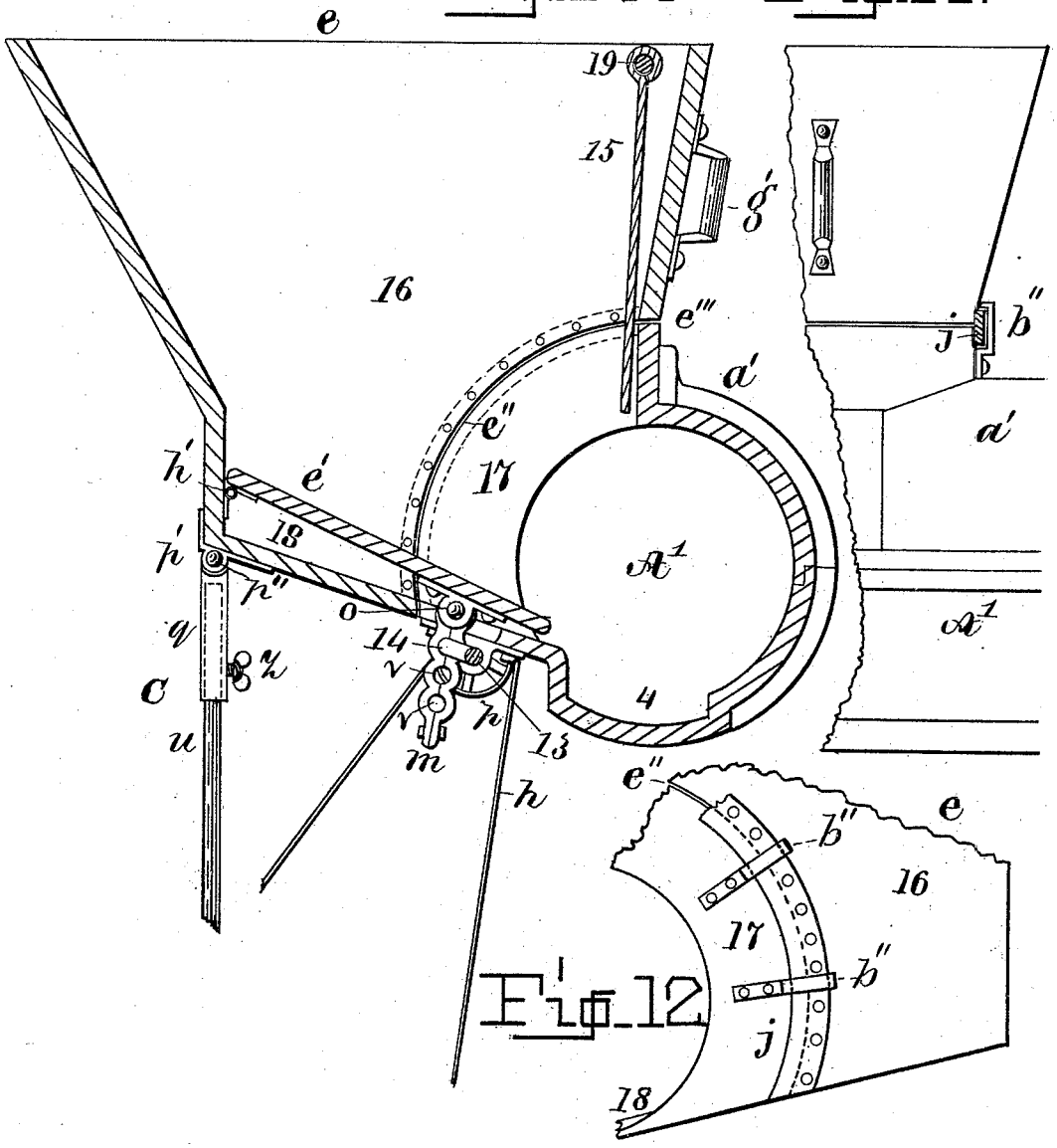

Fig. 11.

Fig. 12.

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UNITED STATES PATENT OFFICE.

THOMAS C. CADWGAN, OF SPRINGFIELD, OHIO.

CRUSHING AND GRINDING MILL.

SPECIFICATION forming part of Letters Patent No. 421,481, dated February 18, 1890.

Application filed October 7, 1889. Serial No. 326,276. (No model.)

To all whom it may concern:

Be it known that I, THOMAS C. CADWGAN, a citizen of the United States, residing at Springfield, in the county of Clark and State of Ohio, have invented certain new and useful Improvements in Crushing and Grinding Mills; and I do 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, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to crushing and grinding mills; and it embraces the combination, with grinding devices, of a series of crushers upon the same shaft with the running-burr. These crushers are of varying capacity. An adjustable hopper and an improved device for regulating the feed are also a part of my improvements.

My invention relates to mills for crushing and grinding corn in the ear and other substances.

The object of my invention is to obtain either coarse or finely ground material by first passing the substances to be reduced through a series of crushers (graded from coarse to fine) on the same shaft, and in the same case with the running-burr, before reaching the grinding devices, I attach a set of finer burrs below the main ones (with a cut-off between the two sets) for flouring, so that one or both sets of burrs may be used.

Figure 1 is a side elevation of a crushing-mill embodying my invention, the leg-supports on the view side being removed. Figs. 2, 3, and 4 are cross-sections of the several parts of the case, having the different crushers therein. Fig. 5 is a vertical longitudinal section of the same with the crushers therein shown entire. Figs. 6, 7, and 8 are plan and end views of the different detachable grooved plates forming the coacting under crushers. Fig. 8* is a view of one of the removable plates, showing the upper surface of the same worn, and a lining-plate inserted beneath the same to compensate for the same. Fig. 9 is a vertical cross-section of the hopper and that part of the case to which it is attached. It shows the adjusting devices of the hopper and the mechanism for vibrating the feed-board. Fig. 10 is an enlarged view (in cross-section) of the same devices shown in Fig. 9. Fig. 11 is a rear view of a portion of the hopper and case. Fig. 12 is a view of a portion of the hopper and shows the means covering the space between the two sections thereof.

My improved crushing and grinding mill consists of a series of spirally-ribbed revolving crushers, all mounted upon the main shaft with the main runner-burr, the size of the crushers and the number of ribs increasing in each one from the first one at the hopper end to the last one in the series at the burr end of the shaft, so as to make the crushing operation a continuous one from coarse to fine as the material is carried through the crushers to the burrs in the same case. The last or finest crusher is preferably cast integral with the running-burr. The lower half-section of the case is divided into compartments by crescent-shaped diaphragms between the crushers, each diaphragm having an opening or throat for the passage of the material from one crusher to another on its way to the grinding-burrs. Beneath each revolving crusher is a detachable ribbed plate. The ribs and grooves in each plate decrease in size and increase in number correspondingly with the increase of the ribs in the crushers as they approach the burrs. The flouring-burrs may consist of any design of burrs for fine grinding, with a case adapted for attachment to the upper one.

As the burrs and case in Figs. 1 and 5 and marked B are the subject of another application filed by me on the 19th day of September, 1889, and serially numbered 324,412, this part is not described or claimed herein. The hopper is adjusted concentrically with the cylindrical periphery of the case, which enables the operator to change the pitch of the bottom or discharging board to any angle desired.

In the drawings, A is the main portion of the mill, inclusive of the case, the several crushers, the burrs, and the adjusting devices of the latter.

A′ is the case, which is in its general form cylindrical, extending from end to end of the main driving-shaft 7, covering all the crushers and the grinding-burrs on said shaft and increasing in size with the series of crushers respectively from the hopper to the burr-case proper, as seen in Figs. 1 and 5, the latter figure showing the crushers *a b c* in the respective parts *a′ b′ c′* of the case. The case is divided longitudinally and the two halves are held together by bolts and nuts in the usual manner. The crushers are formed with projecting spiral ribs 6, the first one (to which the hopper *e* leads on the right end of the case) being smallest, and as it constitutes the first breaker it has but two spiral ribs, which latter are of the greatest pitch of any in the series. The second crusher *b* in part *b′* has four spiral ribs of less pitch than those in crusher *a*. The third crusher *c* has six spiral ribs, also of less pitch than those on crusher *b*. Crusher *c* is the largest in diameter, and it is cast in one piece with the runner-burr *d′*, and as the throat of the still burr *d*, with which the latter coacts, is large enough to allow the crusher *c* to rotate therein freely, the adjustment of the burrs by the hand-wheel and screw 9, engaging shaft 7, is readily effected.

The dotted lines in Fig. 5 represent the field of movement. A portion of crusher *c* is shown broken away to show that it is formed integral with the burr *d′*. The lower half of case A′, in which the crushers *a b c* operate, is divided into the compartments *a′ b′ c′* by the crescent-shaped diaphragms 5 5, as seen in Figs. 2, 4, and 5, a space being left between the crushers for this purpose. Each of these diaphragms has a throat-opening *k* at the middle, directly under the shaft 7, for the passage of the material being operated upon by the crushers. In each compartment there is a downward extension below the cylindrical periphery of the main body, which forms a recess 4 in each of the parts *a b c*, extending the full length of each of the latter. The floor of the space 4 is concentric with the cylindrical lines of the body part of the case, and in each recess is a plate made to conform in shape with the recess, which latter is oblong with parallel sides.

These plates 1 2 3 are each formed with grooves and ribs *t r*, extending in parallel lines longitudinally, and the number and size of the ribs and grooves vary with the number of ribs on the crushers from coarse to fine, respectively. These plates form the respective under crushers and they coact with the crushers *a b c*. They are of chilled cast-iron and have their ribs *r r* ground to form sharp cutting-angles, and the flanges 6 6 of the crushers being also made hard they readily cut and crush the substances passing between them. The plates 1 2 3 are made adjustable to the crushers by ordinary sheet-metal plates 4*, which are inserted under them when the ribs become worn. The diaphragms 5 5 extend to nearly in line with the body part of the crushers and are made thinner toward the top. They are cast in one piece with the lower half-section of case A′, and they serve to retain the material in each compartment until it shall have been crushed as fine as it can be made by the crusher (*a* or *b*) before being discharged into the next compartment of the series. When the crushed material reaches the burrs *d d′*, it is sufficiently pulverized to make the work of the latter (and of the burrs *g* below them) comparatively easy and light, and the expenditure of power is less than when the substances are crushed by a single crusher and ground in the usual manner, as in the latter method the work of the burrs is necessarily increased in greater proportion, as is also that of the crusher. The shaft 7 has a drive-pulley 8 upon one end, and at the burr end a gear-wheel 10, which engages a smaller one 11 on the shaft *i′* of the flouring-burrs *g* below the main grinding-burrs *d d′*. These latter discharge the material passing through them to the lower burrs when it is desired to further reduce it. A cut-off *f*, consisting of a thin metal plate, is provided to slide across the opening between the upper and lower set of burrs. When the lower set of burrs *g* are not in use, the burrs *d d′* discharge through spout *s* in the upper case, and when the flouring-burrs, as *g*, are used the latter discharge through the lower spout *s′* of the lower case. On the right end of shaft *i′* of the lower burrs *g* is a large belt-pulley 12, which transmits power by a belt *h* to a small pulley *p*, on a long horizontal shaft 13, which extends from compartment *c* along the front side of the case under hopper *e* to the right end. It is supported in lugs or hangers *l l*, as seen in Fig. 1.

Directly under the middle of the hopper is a short crank 14, (in shaft 13,) which is pivotally connected by an adjustable two-part link *m* with a pin *o*, passing through ears in a plate attached to the under side of a bottom feed-board *e′*, hinged to the inner front wall of the hopper. The link passes up from the crank through an elongated hole, which is formed in the true bottom of the hopper, playing loosely therein as the machine is operated. The board *e′* is hinged to the inner front wall of the hopper by a hinge *h′* and inclines toward the opposite or discharge end, which latter reaches the opening in the case. As the mill is operated the board *e′* vibrates up and down, the length of the vibrations being determined by the adjustment of the link *m*, which has holes *v v* therein for the purpose. This link is longitudinally divided to allow of the adjustment and held together by bolts and nuts at the ends. For wet or damp corn or other substances, and for oil-cake or other like tenacious material, this vibratory device is useful to facilitate the feed. When the vibratory device is not required, belt *h* is thrown off of pulley 12.

The adjustment of the hopper *e*, as is shown in Figs. 9, 10, 11, and 12, is for the purpose of giving greater or less inclination to its discharge into the case irrespective of the hinged board *e'*. To accomplish this, and at the same time to allow the vibratory devices of this board to operate, the hopper is divided into two sections 16 and 17 along a circular arc *e''*, which extends from a point in the bottom board 18, forward of shaft 13, to the rear wall of the hopper above the case, the rear wall and bottom board being both horizontally divided to intersect the ends of the cleft *e''*. This latter cleft, being concentric with the circular line of the case where the hopper is attached, allows the latter to be drawn backward by a handle *g'* in making the adjustment. To provide for closing the opening between the sections in the rear wall a sheet-metal plate 15 is suspended from the side walls, near the top of the latter, and extends down over the dividing-line *e'''* in the rear wall to the case-opening or near it. This plate is pivoted upon a rod or pins 19, as seen in Fig. 10. The opening in the bottom board is covered by the hinged board *e'*. A semicircular flat plate *j* is secured by its upper edge to the upper section of the hopper 16, and extends down over the cleft *e''*. This plate serves to keep the sections together and to prevent escape of material, and a series of loop-hooks *b''*, consisting of a flat plate of band-iron having an angular hook at the top end bent over the plate *j*, are fastened to the lower section and hold the sections in contact during the sliding movement, which latter is shown in dotted lines, Fig. 9. The circular plate *j* is shown in Figs. 11 and 12, and also in dotted lines, Fig. 10.

The hopper is supported upon the front side by an extension-leg C, which consists of a round rod *u*, sliding in a sleeve *q*, the latter being pivotally attached at its upper end to an angle-iron *p'* on the lower front angle of the upper section 16 of the hopper by a pin *p''*, as seen in Figs. 9 and 10. The rod *u* is held in adjustment by a thumb-screw *z*. The front of the hopper is thrown upward or downward by the adjustment of the leg C, only a slight movement being required to change the inclination of the board *e'*.

In the operation of the mill the spiral flanges convey the crushed material from one to another of the grinding-burrs, and as the pitch angles of these crushers are respectively lessened toward the latter longer retention of the material is thereby effected in passing through crushers *b* and *c*, causing it to be thoroughly and finely crushed when it reaches the burrs *d d'*.

I claim as my invention—

1. In a crushing-mill, a plurality of crushers mounted upon a shaft leading to the grinding devices, said crushers having crushing and conveying flanges increasing in number in the respective crushers as the latter approach the grinding devices, whereby the capacity of said crushers is increased in like ratio with the increased number of said flanges.

2. In a crushing and grinding mill, a plurality of crushers mounted on the same shaft leading to the grinding-burrs, said crushers having crushing and conveying flanges or lugs spirally arranged, increasing in number and lessening in the pitch angles of each of said crushers, respectively, in the series as they approach said grinding-burrs, substantially as and for the purpose set forth.

3. In a crushing and grinding mill, the combination of a main casing having a recess, a plate approximating in size to that of said recess and removably located therein, said plate being held from displacement by the walls of the recess and formed with projecting cutting-ribs, a lining-plate for adjusting said ribbed plate toward the center of the case when said cutting-ribs become worn, and a rotating spiral flanged crusher operating in close relationship with said ribbed plate, all substantially as shown and described.

4. In a crushing and grinding mill, the combination, with a shaft provided with a plurality of crushers, said crushers having spiral flanges increasing in number and lessening in pitch from one crusher to the other, of a plurality of plates beneath said crushers, said plates having ribs and grooves, of which those on one plate are of a greater number and less thickness than those on the next plate, all substantially as shown and described.

5. The combination, with a series of two or more rotary crushers having spiral flanges and the latter increasing in number from the first crusher to the last in the series, respectively, of two or more plates, each having parallel grooves and ribs, and each forming a coacting under crusher to each of said rotary crushers, said plates having the number of grooves and ribs in each decreasing in size and increasing in number with the increase of the number of flanges in said rotary crushers respectively.

6. In a crushing and grinding mill, the combination, with a series of crushers, as *a b c*, on the same shaft, of a case A', having a hopper, as *e*, at one end over the first of the series of said crushers, and the grinding-burrs, as *d d'*, at the opposite end, said case having parts *a' b' c'*, in the order named, corresponding in relative size with the relative size of said crushers, and each of said parts *a' b' c'* having a downward extension of the case to provide a recess, as 4, for each of said under crushers 1 2 3, substantially as set forth, for the purpose described.

7. In a crushing and grinding mill, a case having a compartment for burrs at one end and compartments for crushers in a series in a line extending to the opposite end, said case being divided longitudinally in two sections, and having diaphragms in the lower section cast integral with the latter, said dia-

phragms extending across the lower section, with an opening in each between the compartments in the series.

8. In a crushing and grinding mill, the series of rotary crushers *a b c*, the coacting under crushers 1 2 3, and the burrs *h h'*, in combination with a case having a compartment for the latter at one end, compartments *a' b' c'*, in series adapted for said rotary crushers, having diaphragms 5 5 between them, said case having a recess 4 in each of said compartments in the series, and the coacting under crushers 1 2 3, the latter being removable and adapted to be adjusted to said rotary crushers, substantially as set forth.

9. The combination, with a shaft having a series of crushers mounted thereon, of a main case, within which said shaft and crushers are located, and crescent-shaped diaphragms projecting from said case into the spaces between the adjacent ends of the crushers, said diaphragms being formed with openings for the passage of the material operated upon from one crusher to another.

10. The combination, with the case A' and the crushing and grinding devices, of a hopper divided into two sections, its rear and front or bottom walls divided horizontally and its side walls circularly, the division-lines of the latter being concentric with the axial line of said case, whereby it is adapted to be adjusted around the wall of the latter, substantially as hereinbefore set forth.

11. The combination, with the case and the hopper divided into sections, one of which is movable, of an extension-leg, one section of said leg sliding into a pivoted sleeve forming the other section, and the latter being attached to the movable section of said hopper, with means for securing said movable section when adjusted.

12. The combination, with a hopper having a fixed and a movable section and divided into sections, one of which is movable, whereby the adjustment is effected around the opening in the case and cutting the axial line of the latter, of a handle attached to said movable section, and an adjustable leg to support it when adjusted.

13. The combination, with a casing, a hopper having a fixed and a movable section, its side walls being divided into arcs of circles, and its movable section adapted to be drawn backward beyond the normal line of its rear wall, and means for adjusting said hopper, of a swinging plate hinged or pivoted to the side walls to cover the opening made in adjusting between the two sections of said rear wall.

14. In a grinding-mill, the combination, with the hopper, of a hinged bottom board, with means for vibrating the latter, consisting of a rotary shaft having a pulley and crank thereon, a divided adjustable link pivotally connecting said crank with a plate on said hinged bottom board, and a belt connecting the pulley on said rotary shaft with a pulley on the shaft of the running-burr.

15. The combination, with a casing, a divided hopper having its front or bottom and its rear wall longitudinally divided, means for adjusting said hopper, and a circular cleft in its side walls concentric with the section of the case to which it is attached, of a flat circular plate attached to the movable section and overlapping the fixed section of said hopper, loop-irons clasping over said flat circular plate and operating, in connection with the latter, to retain the movable section of said hopper in juxtaposition with the fixed section during the adjustment, as set forth.

16. In combination, a case having lugs or hangers, a shaft rotating in the latter and provided with a crank, a hopper adapted for adjustment concentrically from the line of said shaft over said case, a hinged bottom board in the movable section of said hopper and extending into the fixed section, said bottom board having an attachment for pivoting thereto, and an adjustable link connecting the latter with said crank, with the means described for operating said shaft.

17. In a crushing and grinding mill, a case of general cylindrical form having a hopper-opening, an adjustable hopper in two sections attached to said case over the opening, said hopper being divided concentrically with the case of said mill, whereby a partial rotary movement of the movable section of said hopper is described over the fixed section in the adjustment, and a hinged feed-board adapted to cover the opening made in the bottom board by sliding one section of the hopper over the other in making the adjustment, as set forth.

18. The combination, in a crushing and grinding mill, with a case, a hopper, and a feed-board for said hopper, of means for vibrating said feed-board, consisting of a rotary shaft having a crank, and a longitudinally-divided link connecting said feed-board and crank together and adjustable by means of its holes to adjust the throw given to said feed-board.

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

THOMAS C. CADWGAN.

Witnesses:

B. C. CONVERSE,

FLETCHER WHITE.