H. G. McCULLOCH.

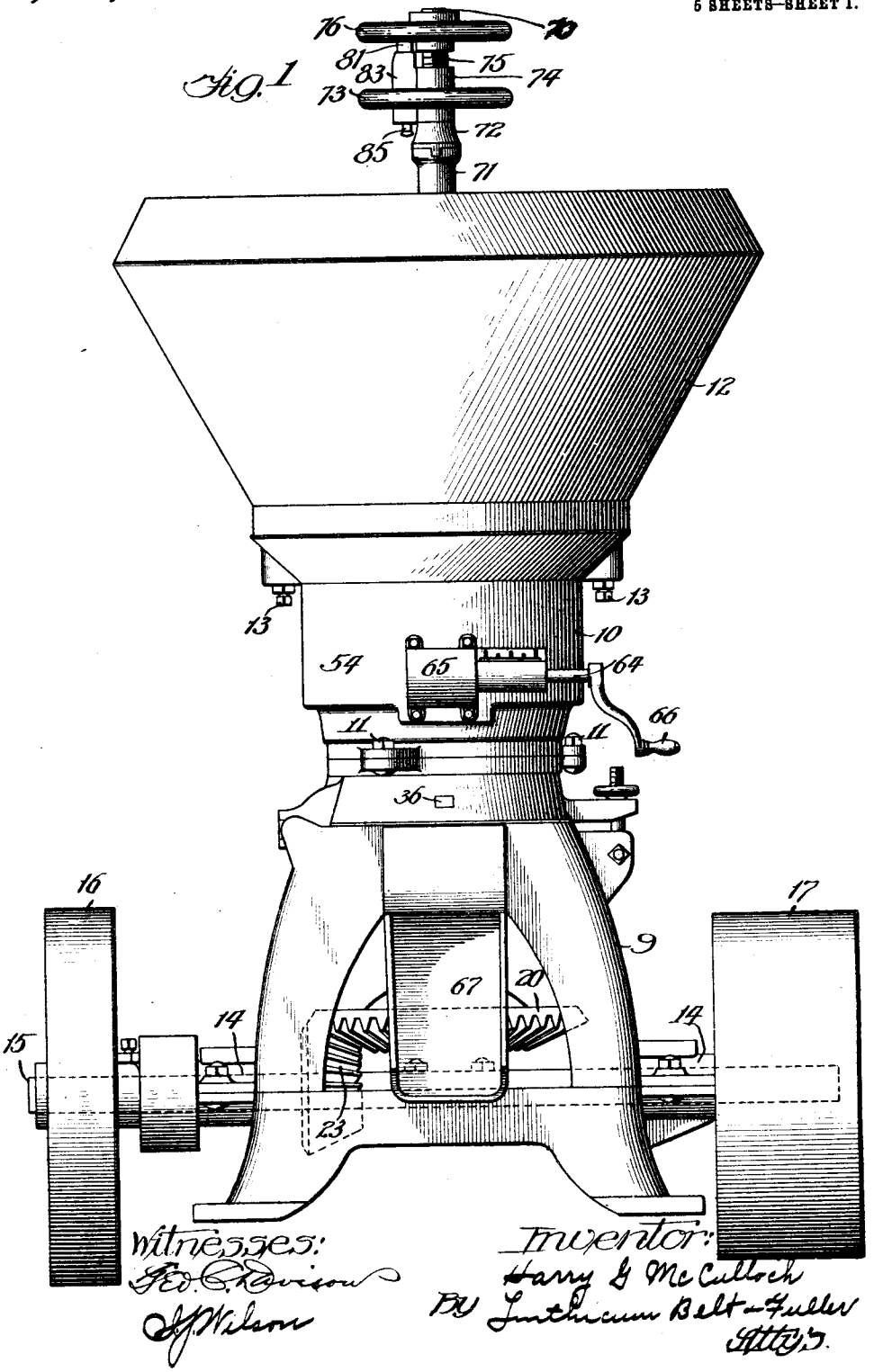
FEED MILL.

1,050,369.

Patented Jan. 14, 1913.

5 SHEETS—SHEET 1.

Fig. 1



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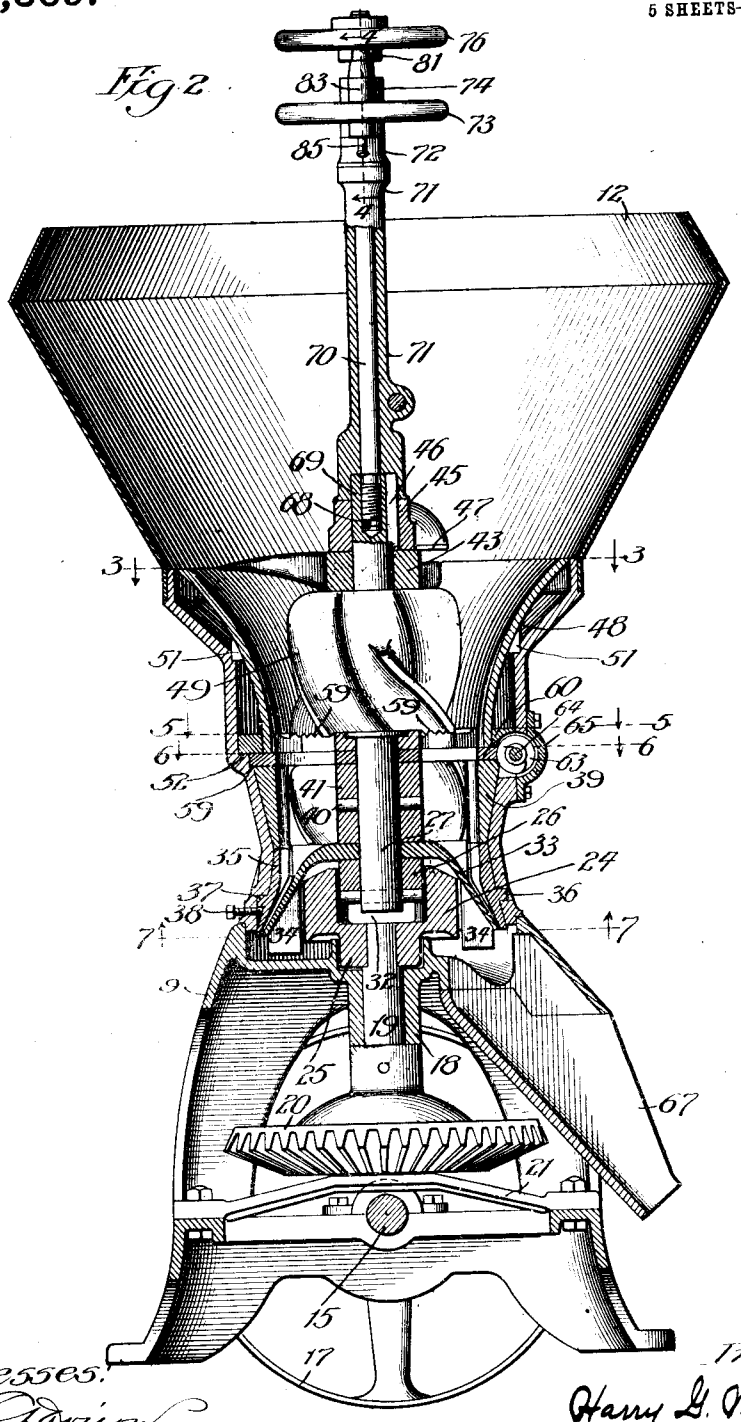
5 SHEETS—SHEET 2.

Fig. 2.



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5 SHEETS—SHEET 3.

Fig. 3.

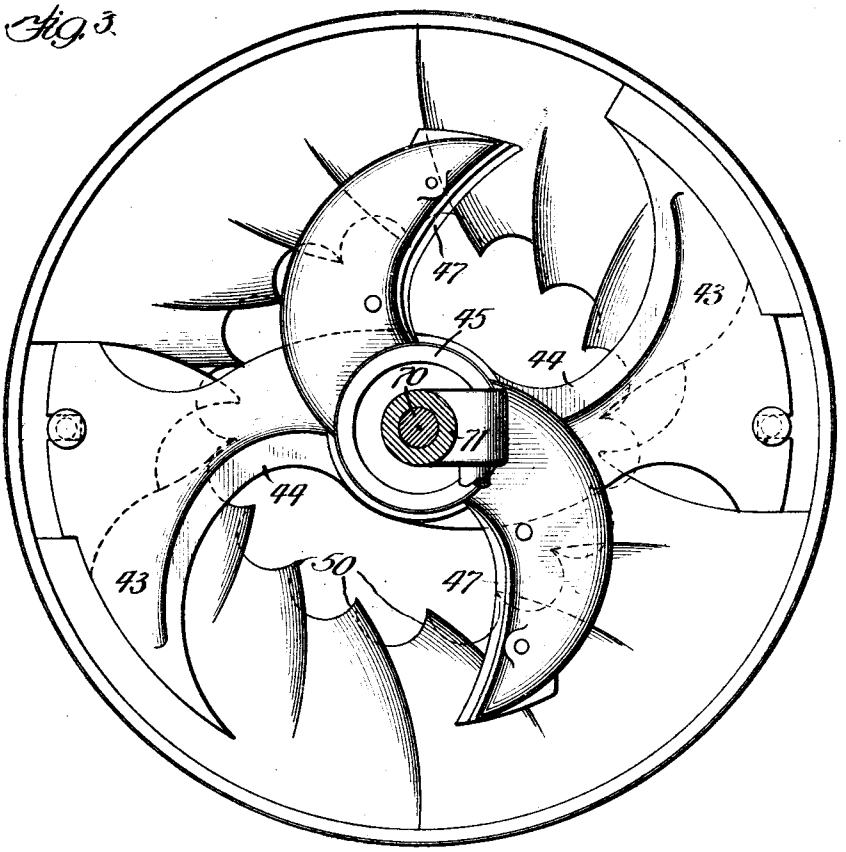
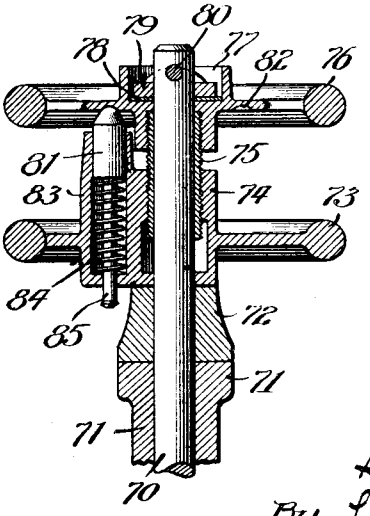


Fig. 4



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5 SHEETS—SHEET 4.

Fig. 5.

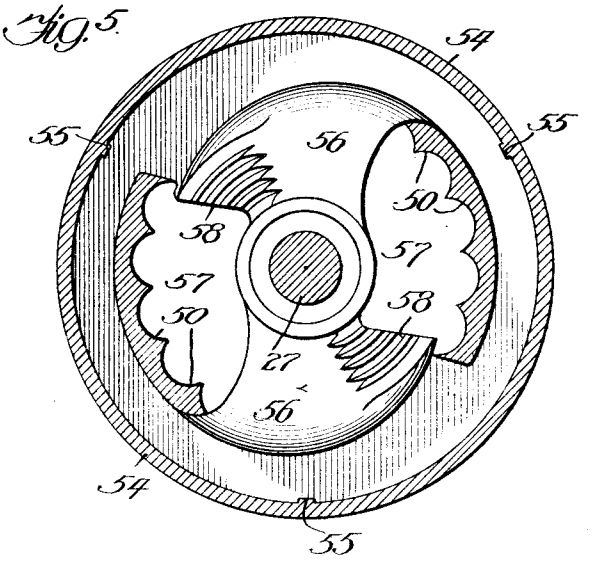
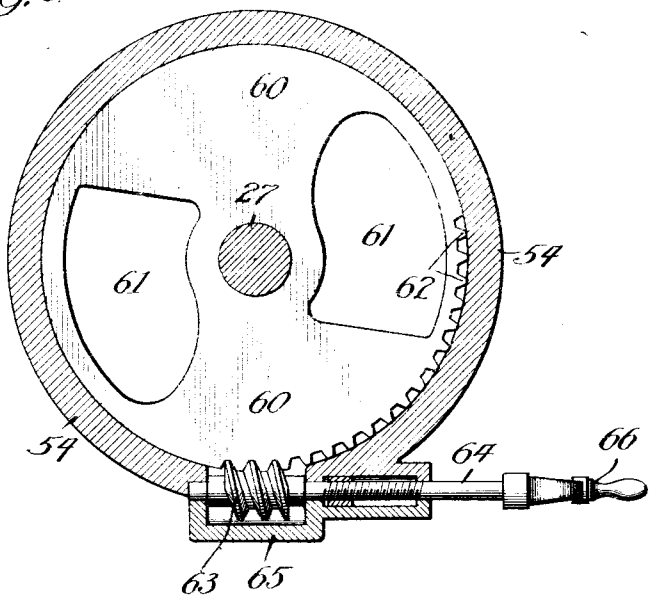


Fig. 6.



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5 SHEETS—SHEET 5.

Fig. 7.

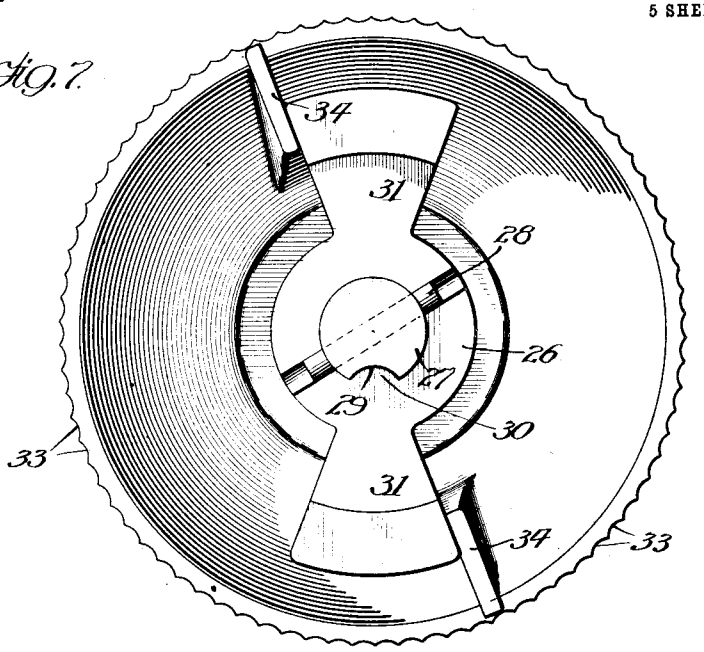
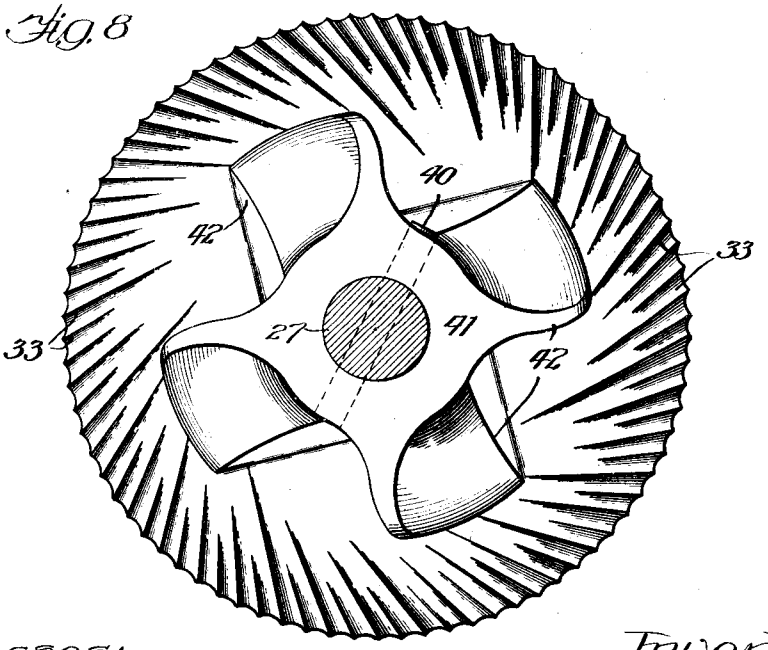


Fig. 8



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UNITED STATES PATENT OFFICE.

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FEED-MILL.

1,050,369. Specification of Letters Patent. Patented Jan. 14, 1913.

Application filed May 20, 1910. Serial No. 562,371.

To all whom it may concern:

Be it known that I, HARRY G. McCULLOCH, a citizen of the United States, residing at Freeport, in the county of Stephenson and State of Illinois, have invented certain new and useful Improvements in Feed-Mills, of which the following is a specification.

This invention relates to feed mills of the general type commonly known as vertical mills, and has for its aim the general improvement of mills of this type and particularly the improvement of the breaker mechanism and the bur adjusting mechanism.

One of the objects of this invention is the provision of a breaker mechanism which will effectually break and crush cobs, stalks, etc., so that they will readily feed to the grinding burs, and which will not clog or become stopped up by large pieces of material.

Another object of the invention is to provide improved mechanism for feeding of the material and to so locate such mechanism that the breakers will coöperate therewith to facilitate the feeding operation.

Still another object is the provision of improved mechanism for adjusting the grinding burs, by means of which the burs may be adjusted when the mill is in operation, and which will support the weight of the revolving bur and will offer the least amount of frictional resistance to the rotation of the bur.

Further objects and advantages of the present invention will best be made clear by the following description and accompanying drawings of one form of means for carrying the invention into practical effect, it being understood that said invention is not circumscribed by the details of said means, the true scope thereof being defined by the claims.

Referring to the drawings—Figure 1 is an elevation of a mill embodying my invention. Fig. 2 is a vertical sectional view taken substantially through the center of the machine looking toward the right in Fig. 1. Fig. 3 is a section on the line 3—3 of Fig. 2. Fig. 4 is a sectional view on the line 4—4 of Fig. 2. Figs. 5 and 6 are sectional views on the lines 5—5 and 6—6, respectively, of Fig. 2. Fig. 7 is a section on the line 7—7 of Fig. 2, looking upward; and, Fig. 8 is a section taken just below the feed plates looking downward.

On the drawings, 9 designates the main base of the machine, and 10 the auxiliary base rigidly secured to the main base by the bolts 11, and carrying at its upper end the hopper 12 secured thereto by suitable bolts 13. The main base is provided with suitable bearings 14 in which is journaled the horizontal shaft 15 having the balance-wheel 16 and the drive-pulley 17 secured near either end thereof. The main base is constructed to provide a centrally disposed bearing 18 adapted to receive a vertical stub-shaft 19 to the lower end of which is secured a bevel-gear 20. The lower end of the shaft is supported in a bearing provided on the web 21 bolted to the base of the machine as shown in Fig. 2. A bevel-pinion 23 fixed upon the shaft 15 is adapted to mesh with and drive the bevel-gear 20 to impart a rotary movement to the vertical shaft 19.

The upper end of the vertical stub-shaft 19, is shouldered to receive a knuckle or driver 24 adapted to rotate in a bearing 25 formed in the top of the vertical bearing 18. The driver is provided with a slotted opening extending longitudinally of the driver, downward from its top, and adapted to loosely receive the bur-driver 26 secured upon the lower end of a vertical shaft 27 by means of a pin 28, the driver being further insured against rotation on the shaft by reason of the concave groove 29 extending longitudinally of the shaft, into which the convex shoulder 30 on the bur-driver 26 is adapted to fit, as best shown in Fig. 7. The bur-driver is provided with a pair of laterally extending wings 31 and telescopes loosely into the driver 24 by means of which the bur-driver is rotated. This driving connection permits longitudinal adjustment of the bur-driver and shaft 27 relatively to the driver 24 and also lateral movement of the shaft and the rotating bur carried thereby to permit self-adjustment of the grinding burs one to the other. This driving connection also permits the machine to operate even though the shafts 19 and 27 should be

out of alinement by reason of imperfections in the machine castings, or as the result of wear.

Upon the shaft 27 immediately above the bur-driver 26, there is loosely mounted the frusto-conical shaped grinding bur 33 provided on its lower and inner surfaces with a pair of integral lugs 34 with which the wings 31 on the bur-driver are adapted to engage as the driver is rotated to revolve the grinding bur. The outer surface of the revolving bur is corrugated in the usual manner, as best shown in Fig. 7, to coöperate with the stationary grinding bur 35 disposed within the lower part of the auxiliary base 10. The stationary bur is maintained in position by the engagement of a laterally projecting lug 36 in an opening in the wall of the auxiliary base and by the engagement beneath a similar lug 37 oppositely disposed on the stationary bur of a locking set-screw 38, as shown in Fig. 2. In assembling the machine, the stationary bur is inserted from the lower end of the auxiliary base before this base is positioned on the main base, the lug 36 being engaged in the opening adapted to receive it; whereupon the set-screw 38 is threaded into the auxiliary base to engage beneath the lug 37 and maintain the stationary bur in position. The inner surface of the stationary bur is also corrugated in the usual manner to coöperate with the corrugated surface of the revolving bur.

Within the auxiliary base and immediately above the stationary bur, there is positioned a stationary annular breaker member 39, and upon the shaft 27 immediately above the revolving bur 33 there is secured by means of a pin 40, a revolving feed device or breaker member 41, as shown in Figs. 2 and 8. The revolving feeder or breaker member is shown as comprising four laterally projecting and spirally arranged ribs or blades 42. It will be evident, however, that the number of blades may be diminished or increased, if desired, as the character of the material being ground, demands. The stationary breaker member 39 is corrugated on its inner surface to coöperate with the revolving breaker member to reduce the size of the pieces of material being ground, so that they will freely enter between the grinding burs. Rotation of the stationary member may be prevented in the auxiliary base by a groove and rib connection between the member and base or by the use of a set-screw or other equivalent fastening means.

To the auxiliary base 10 near its upper end there is secured by bolts or other preferred fastening means, a cross-bar 43 which serves as a bearing for the upper end of the shaft 27, as shown in Fig. 2. The cross-bar is curved as shown in Fig. 3, and the forward and upper edges of the bar on opposite sides of the main shaft, are thickened and sharpened as at 44 to coöperate with a cutter 45 splined to the shaft 27 at 46 and comprising a pair of arms, each provided with a cutting blade 47 detachably secured to the arm by means of rivets and adapted upon revolution of the shaft to coöperate with the cutting surfaces of the cross-bar to cut and tear the material, such as stalks, ears of corn or fodder being fed into the mill.

Beneath the cross-bar there is supported in the auxiliary casing a flaring stationary breaker member 48, and upon the shaft in cooperative relation to the stationary feeder or breaker member, is fixed a revolving breaker member 49 comprising a plurality of spirally disposed blades similar to the breaker member 41 above described. As best shown in Fig. 3, the stationary breaker member 48 is corrugated on its inner face, the lower ends of the corrugations terminating in curved pointed tearing surfaces 50. These corrugations and tearing portions in coöperation with the revolving blades of the revolving breaker member, serve to tear and crush to a considerable extent, the material being fed before it enters between the lower breaker comprising the revolving member 41 and the stationary member 39. Both the stationary breaker members 39 and 48 are preferably mounted eccentrically with respect to the main shaft so that one portion of the members is disposed farther away from the revolving feeder or breaker members than the remaining portions. This eccentricity is very slight and is not evident from a casual inspection of the drawings. Nevertheless it is sufficient to materially assist the feeding of the material between the breaker members for the reason that the larger pieces will be carried around by the revolving breaker to the point of greatest eccentricity where they are fed downward under the influence of gravity, and as they are engaged between the stationary and revolving breaker members, will be broken and torn and eventually fed between the grinding burs. The stationary breaker member 48 is maintained in position in the auxiliary base by suitable lugs 51.

An internal annular shoulder 52 is provided within the auxiliary base to support the stationary breaker plate 48, as shown in Fig. 2. The lower end of the stationary breaker member 48 is disposed within an annular flange 54 on the breaker plate viewing Fig. 5, and is cut away at a plurality of points around its circumference to engage with a plurality of lugs 55, thereby preventing the stationary feed plate from turning. The stationary plate is provided with a spider 56 extending across the plate and having an opening in its center to accommodate the main shaft 27. Suitable feed-open-

ings 57 are provided on either side of the plate, the outer walls of the openings being corrugated to correspond to the corrugations in the stationary breaker member 48. The edges of the spider adjacent the larger end of the feed openings, are raised slightly above the remaining portions of the plate and are provided with suitable concentrically arranged corrugations 58 with which are adapted to coöperate similar corrugations 59 on the lower ends of the blades of the revolving breaker member 49. The action of the interengaging corrugated portions of the feed plate and revolving breaker, assists in cutting and tearing the fodder so that it will more readily feed through the plates.

Immediately beneath the stationary feed plate there is supported by the stationary breaker members 39 and the annular shoulder 59 on the auxiliary base of the machine, a suitable feed plate 60. The plate 60 is arranged concentrically with the main shaft which is disposed through the center of the plate and is provided with feed openings 61 similar in shape to the feed opening 57 in the stationary feed plate. For the purpose of adjusting the plate relatively to the stationary plate, a series of teeth are provided around a portion of the periphery of the adjustable plate to provide a sector 62 with which is adapted to mesh a worm 63 secured upon a shaft 64 mounted in suitable bearings provided by the wall of the auxiliary base 10, and a cap 65 bolted to the auxiliary base, as shown in Fig. 2. The outer end of the shaft 64 is provided with a suitable operating handle 66 by means of which the position of the adjustable feed plate may be adjusted to regulate the size of the feed openings through the plates.

It will be evident that the material in the hopper 12 is first cut and torn by the action of the cutter blades 47 in conjunction with the cutting edges of the cross-bar 43. The material is next broken up and fed downwardly by the upper breaker comprising the stationary feeder member 48 and the revolving member 49, and before being fed through the plates, it is further cut and torn by the coöperative action of the lower edges of the revolving breaker member blades in conjunction with the corrugated upper surface of the spider 56 on the stationary feed plate. The material is now sufficiently crushed and torn to permit it to pass through the feed plates, the amount of material being fed through the plates being capable of regulation by means of the adjusting handle 66, which positions the openings of the adjustable plate relatively to the openings of the stationary plate. As the material passes through the feed plates, it is next acted upon by the lower breaker consisting of the stationary feeder or breaker member 39 and the revolving member 41. As will be evident from Fig. 2, the stationary and revolving members of the lower breaker are positioned closer to each other than the members of the upper breaker to further crush and tear the material so that it will readily feed between the grinding burs 33 and 35. After the material has been ground by the burs, it is discharged from the mill through the discharge spout 67.

In order that the relative positions of the grinding burs may be adjusted for the purpose of producing different grades of feed, I have provided an improved adjusting mechanism whereby the revolving bur may be adjusted toward and from the stationary bur during the normal operation of the machine. As has been previously explained, the cross-bar 43 which is rigidly secured to the upper end of the auxiliary base, forms a bearing for the upper end of the shaft 27 which projects therethrough and has splined thereon above the cross-bar, the cutter member 45. As best shown in Fig. 2, the upper end of the shaft 27 is threaded internally at 68 to receive the threaded lower end 69 of a spindle 70. A standard 71 is loosely mounted on the spindle 70 and is supported at its lower end upon the cutter 45. Upon the upper end of the standard and loosely surrounding the shaft, there is supported a collar 72, as best shown in Fig. 4. A lower hand-wheel 73 rests upon the collar 72 and is provided with a centrally disposed stud 74 which is internally threaded for the reception of a sleeve 75 rigidly affixed to the upper hand-wheel 76 and loosely surrounding the shaft 70. A cup-bearing 77 is provided on the upper face of the hand-wheel 76 for the reception of a fibrous washer 78 upon which is disposed a bearing washer 79 which is attached to the spindle 70 to revolve therewith by a pin 80. It will be evident that the weight of the spindle 70 is carried by the bearing washer 79 which in turn is supported by the upper hand-wheel 76, the lower hand-wheel 73, the collar 72 and the standard 71, from the cross-bar 43. As has been previously explained, the shaft 27 carrying the revolving bur 33 is capable of vertical adjustment relatively to the driver 24 because of the telescoping connection between the driver and the bur driver secured on the shaft.

As shown in Fig. 2, the spline 46 by means of which the cutter 45 is secured to the main shaft, extends above the cutter to engage the standard 71 whereby the standard is also rotated with the shaft. During the normal operation of the machine the collar 72 and both the hand-wheels 73 and 76 are capable of and usually do rotate with the shaft and spindle 70, although it will be evident that they may remain stationary and the relative

turning movement may take place between the bearing washer 79 and the fibrous washer 78, it being well understood, of course, that a liberal supply of lubricant is maintained in the cup-bearing 77.

By turning one of the hand-wheels 73 or 76 relatively to the other, the distance between the wheels will be varied because of the screw-threaded connection between the threaded stud on the wheel 73, and the threaded sleeve 75 which is rigidly secured to the wheel 76. As the wheel 76 is adjusted upwardly and downwardly relative to the wheel 73, the spindle 70 and the shaft 27 carrying the revolving bur 33, are moved upwardly and downwardly to adjust the position of the revolving bur relatively to the stationary bur. By means of this adjusting mechanism the grinding burs may be adjusted to produce a coarse or fine grade of feed, as desired, and this adjustment may be made while the mill is running under normal working conditions.

In order to prevent relative rotation of the hand-wheels during the normal operation of the mill, I have provided a yielding lock for connecting the wheels, which comprises a plunger 81 having a rounded outer end adapted to engage with any one of a series of depressions 82 in the lower face of the upper hand-wheel. The plunger is mounted to operate in a cylindrical casing 83 integral with the lower hand-wheel, and is normally urged into engagement with the upper hand-wheel by the expansion spring 84 surrounding the spindle 85 of the plunger.

During the normal operation of the machine the hand-wheels may either remain stationary or they may revolve together with the spindle 70. When it is desired to adjust the relative position of the grinding burs the hand-wheels may be grasped, one in either hand, and turned relatively one to the other to either thread the sleeve 75 farther into the stud 74, thereby separating the revolving bur from the stationary bur, or, by turning the wheel in the other direction, to raise the upper hand-wheel relatively to the lower to thereby bring the revolving bur into closer proximity with the stationary bur.

From the foregoing it is thought that the construction, operation, and many advantages of the hereindescribed invention, will become apparent to those skilled in the art, without further description, and it will be understood that various changes in the size, shape, proportion and minor details of construction, may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

What I claim is:

1. In a feed mill, the combination of a shaft, a plurality of revolving breaker members secured on said shaft, and a feed controlling device located between said breaker members to control the feed from one breaker to another, said device comprising a stationary plate adapted to coöperate with one of said breakers and a rotatable plate coöperating with the stationary plate.

2. In a feed mill, the combination of a rotatable shaft, a plurality of breaker members secured thereon, a plurality of corresponding stationary breaker members each being adapted to coöperate with one of said rotatable breaker members, a grinding device disposed beneath said breaker members, and an adjustable feed controlling device positioned between the pairs of breaker members and comprising a pair of relatively movable plates, the surface of one of the plates being roughened to coöperate with one of said rotatable breakers.

3. In a feed mill, the combination of a plurality of stationary breaker members spaced apart one above the other, a plurality of revolving breaker members adapted to coöperate with said stationary members, a grinding device disposed beneath said breaker members, a pair of perforated feed plates positioned between successive breakers, one of said plates being roughened to coöperate with an adjacent breaker member, and means for adjusting one of said plates to regulate the feed from one set of coöperating breaker members to the next.

4. In a feed mill, the combination of a driving shaft, a slotted driver mounted thereon, a bur shaft, a winged bur driver fixed on the bur shaft and loosely engaging with the slotted driver to permit of relatively longitudinal and lateral movements between the slotted and winged drivers, and a bur mounted on the bur shaft in position to be driven by the winged driver.

5. In a feed mill, the combination of a vertical shaft, a stationary breaker member, a revolving breaker member secured on said shaft to coöperate with said stationary breaker member, a stationary feed plate connected with the stationary breaker member, an adjustable feed plate disposed beneath said stationary plate, a stationary breaker member positioned beneath and adjacent the adjustable plate, a revolving breaker member secured on said shaft in coöperative relation to said last mentioned stationary breaker member, a stationary grinding bur below said lower breaker members, and a coöperating grinding bur on said shaft.

6. In a feed mill, the combination of a rotatable vertical shaft, a plurality of breaker members fixedly secured on said shaft, a plurality of stationary breaker members disposed in coöperative relation with said rotatable members, a grinding device below said breaker members, a station-

ary feed plate located between the pairs of breaker members, an adjustable feed plate positioned adjacent the stationary plate, and means for adjusting said adjustable plate whereby to vary the size of the feed opening through said plates.

7. In a feed mill, the combination of a plurality of superposed stationary breaker members, a stationary grinding bur, a main shaft, a rotatable grinding bur mounted on said shaft to coöperate with said stationary grinding bur, a plurality of superposed rotatable breaker members fixed on said shaft in coöperative relation with said stationary breaker members, respectively, a stationary feed plate disposed between the upper and lower breaker members and having a serrated upper face, the lower end of said upper revolving breaker member being serrated to coöperate with said serrated feed plate, and a cutter member secured to said shaft above said breaker members.

8. In a feed mill, the combination of a pair of spaced apart stationary breaker members, a stationary feed plate and an adjustable feed plate coöperatively positioned between said stationary breaker members, a pair of rotatable breaker members disposed in coöperative relation to said stationary breaker members, a stationary grinding bur, and a rotatable grinding bur mounted to rotate in coöperative relation adjacent said stationary grinding bur.

9. In a feed mill, the combination of a feed plate provided with serrations on its upper surface, and a revolving breaker member comprising a plurality of wings having serrated lower edges to coöperate with the serrated face of said feed plate.

10. In a feed mill, the combination of a rotatable shaft, a breaker member fixed concentrically on said shaft, and a stationary breaker member encircling the rotatable breaker member, the throat of said stationary breaker member being formed in the shape of a double eccentric with respect to the rotatable member and having converging ribs extending spirally to facilitate the feeding of the material to be ground and terminating in curved pointed tearing surfaces.

11. In a feed mill, the combination of a rotatable shaft, a pair of breaker members spaced apart and securely fixed on said shaft concentrically therewith, and a pair of stationary breaker members surrounding the rotatable breaker members and disposed in coöperative relation therewith, the throat of one of said stationary members being arranged eccentrically of its revolving breaker member and having spirally arranged cutting devices whereby to facilitate the feeding between said members of the material to be ground.

12. In a feed mill, the combination of a vertically disposed shaft, means for supporting said shaft, a revolving bur mounted on said shaft, a stationary bur encircling said revolving bur, a bur driver mounted on the shaft, a driving shaft, and a slotted driver mounted on said driving shaft having loose connections with said bur driver to permit relative movements between said shafts both longitudinally and laterally without breaking the driving connection between them.

13. In a feed mill, the combination of a stationary grinding bur, a rotatable shaft, a rotatable grinding bur secured thereon, a spindle from which said shaft is suspended, a supporting standard surrounding said spindle, a hand-wheel loosely mounted upon the spindle and supported by said standard, a second hand-wheel supported by said first mentioned hand-wheel and having a threaded connection therewith, a yielding lock for preventing relative rotation of said hand-wheels, and a bearing member carrying said spindle and supported upon said upper hand-wheel whereby relative rotative movement of the hand-wheels will impart a longitudinal movement to said spindle to vary the distance between said grinding burs.

14. In a feed mill, the combination of a pair of grinding burs, means for driving one of said burs, a telescoping connection between said driving means and said driven bur, a pair of hand wheels, a locking device carried by one of said wheels for normally locking said wheels against relative rotation, an adjustable connection between said wheels whereby rotation of one of the wheels relatively to the other will vary the distance between the wheels, and connections between one of said wheels and said driven bur, whereby relative rotation of the wheels will adjust the relative positions of said grinding burs.

15. In a feed mill, the combination of a pair of grinding burs, a rotatable shaft upon which one of said burs is mounted, means for driving said shaft, telescoping connections between said shaft and said driving means, a pair of hand wheels loosely mounted on said shaft, a standard adapted to support said hand-wheels, screw-connections between said hand-wheels, whereby rotation of one of the wheels relatively to the other will vary the distance between said wheels, and operative connections between one of said wheels and said shaft whereby said shaft is moved longitudinally by said wheel and the burs relatively adjusted.

16. In a feed mill, the combination of a grinding bur, a longitudinally movable shaft upon which said bur is mounted, driving means for said shaft, a telescoping connection between said shaft and said driving

means, a standard, a hand-wheel loosely mounted on said shaft and supported by said standard, a second hand-wheel loosely mounted on said shaft, a screw connection between said wheels whereby rotation of one of the wheels relatively to the other will vary the distance between said wheels, connections between said second wheel and the shaft, and a yielding lock normally holding said wheels against relative rotation to maintain the shaft and grinding bur in adjusted position.

17. In a feed mill, the combination of a standard, a shaft mounted in said standard, a grinding bur secured on said shaft, a stationary bur, a lower hand-wheel loosely mounted on said shaft and supported upon said standard, an upper hand-wheel loosely mounted on said shaft and provided with a sleeve surrounding said shaft, said sleeve being adapted for screw-threaded engagement with the lower hand-wheel whereby rotation of one of said wheels relatively to the other, will vary the distance between said wheels, means for normally locking said wheels against relative rotation, and a collar secured to said shaft and supported upon the upper face of the upper hand-wheel whereby rotation of either of said hand-wheels will vary the vertical position of the upper hand-wheel to adjust said shaft longitudinally.

18. In a feed mill, the combination of a vertically disposed hopper, a breaker adapted to rotate within said hopper, and spirally extending means located within the hopper and adapted to coöperate with said breaker to feed the material downwardly.

19. In a feed mill, the combination of a vertical hopper, a vertically disposed stub shaft, means for rotating said shaft, a main shaft mounted to be rotated by said stub shaft but capable of longitudinal movement relatively thereto, a stationary grinding bur and a pair of superposed stationary breaker members mounted beneath said hopper, a rotatable grinding bur, a pair of superposed rotatable breaker members and a rotatable cutter carried by said main shaft, a spindle from which said main shaft is supported, and a pair of adjusting wheels having screw-threaded engagement one with the other whereby said wheels may be adjusted toward and from each other to raise and lower the main shaft.

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