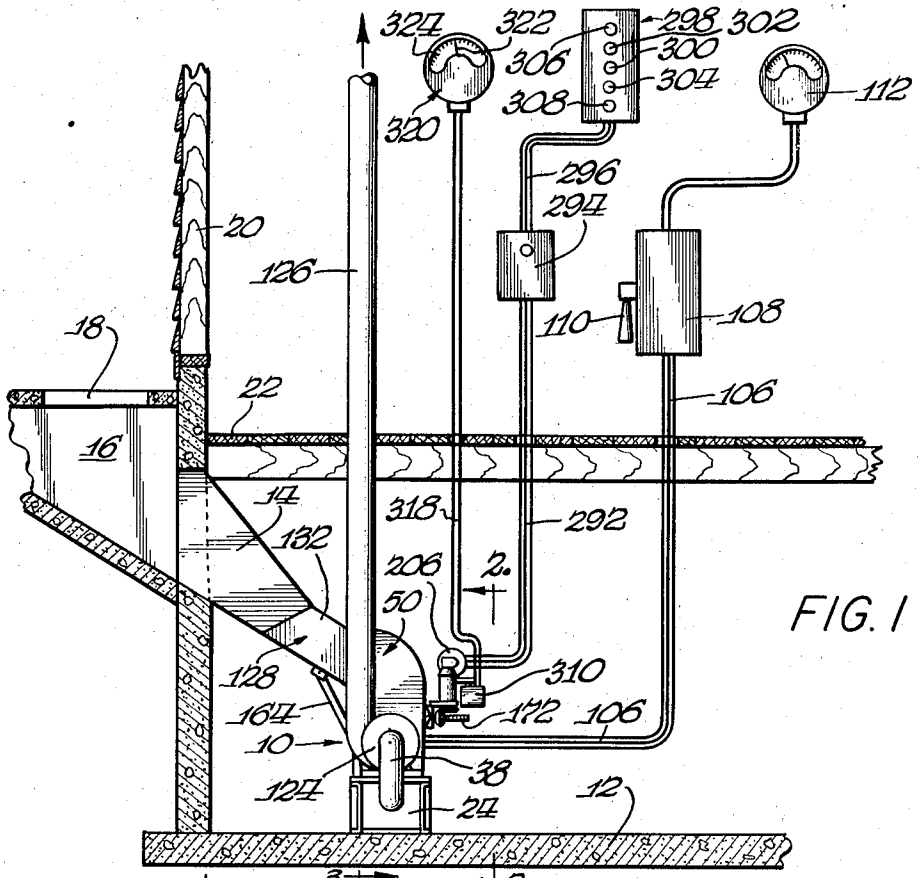
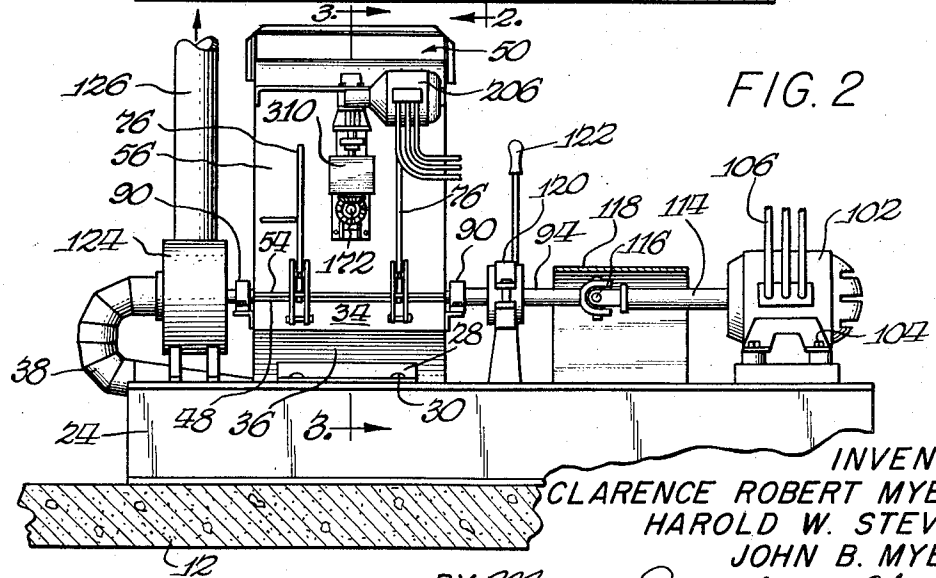
May 26, 1959 C. R. MYERS ET AL 2,888,211

HAMMER MILL

Filed April 25, 1955 3 Sheets-Sheet 1





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HAMMER MILL

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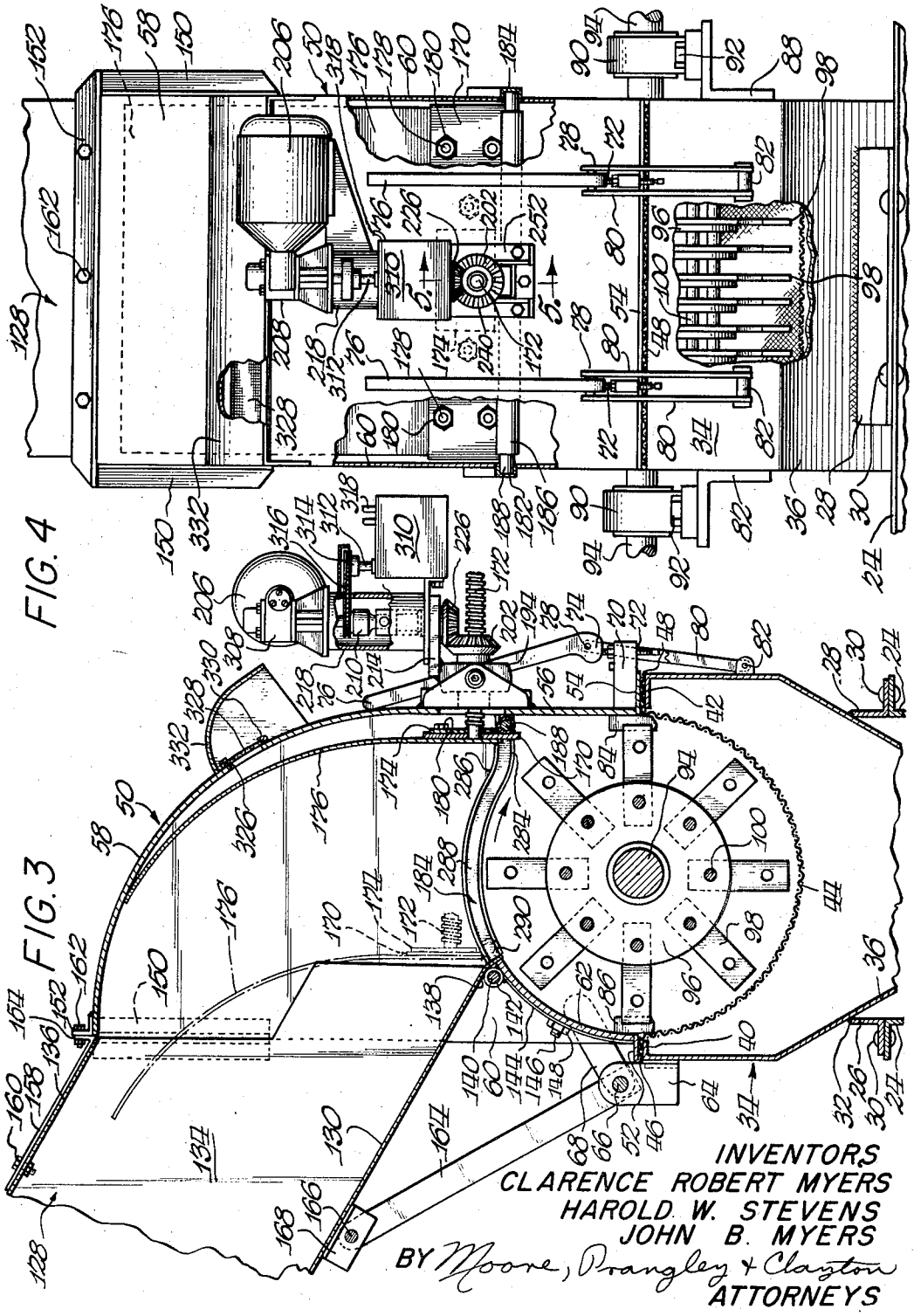


FIG. 4

FIG. 3

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HAMMER MILL

Filed April 25, 1955 3 Sheets-Sheet 3

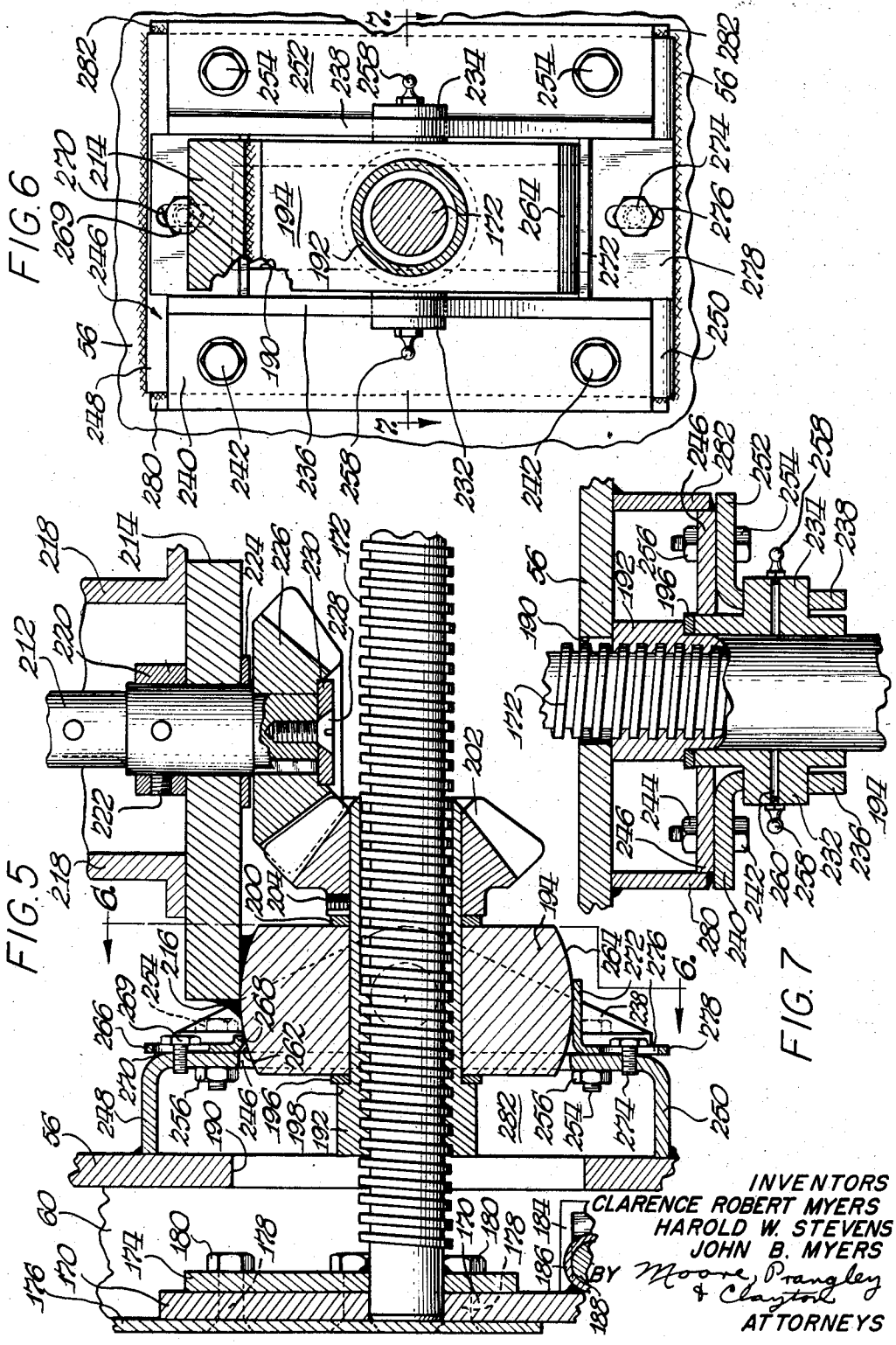


FIG. 6

FIG. 5

FIG. 7

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2,888,211

HAMMER MILL

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Application April 25, 1955, Serial No. 503,734

4 Claims. (Cl. 241—37)

This invention relates to hammer mills and particularly to improved feed and control mechanisms for suspension type hammer mills.

The improvement of the present invention relates to hammer mills of the type in which the material to be ground is fed substantially tangentially to a set of rotating and pivotal hammers past a grinding plate. As the material drops from the grinding plate it falls into the path of the rotating hammers which are rotating in a direction such that the path of travel adjacent the grinding plate is in the same direction as the movement of the material being ground. The hammers initially grind the material while it is suspended in mid air and accordingly this type of hammer mill is referred to as a "suspension" type hammer mill. The ground material is carried by the hammers downwardly and across a screen. If the material has been ground to the desired degree of fineness, it passes through the screen and is carried by a pneumatic conveying system to a collection point where it is stored, put into bags, or otherwise disposed of.

In machines of this type used heretofore, it has been difficult to regulate the feed past the grinding plate in such a manner as to operate the prime mover for the hammers at its optimum rated capacity and still maintain the desired fineness of grinding. If the hammer mill was run at its optimum capacity, the degree of grinding was not proper and, vice versa, if the desired degree of grinding was obtained, the hammer mill was not operating at optimum efficiency. It further was found in these prior machines that it was necessary to change the screens through which the ground material passed on its way to the pneumatic conveying system for each desired degree of final fineness of the ground product. In grinding feed materials for livestock, it is desired that certain of the feed materials be ground to a fineness such that they may pass through a 3/64 inch screen whereas other material may only be ground to a fineness such that it will pass through a 1¼ inch screen. Since the hammer mill itself often is placed in the basement of the mill and the feed, bagging and control mechanism are positioned on the first floor of the mill, it has been inconvenient and time consuming to change the screen in the hammer mill when changing the type of material being ground.

The operation of the pneumatic conveying systems in prior suspension hammer mills has also been hampered by lack of sufficient air supply passing down past the hammers. In those structures in which additional air supply past the hammers has been supplied, the additional air supply carried unground material with it around the grinding plate so that the material was of necessity ground against the screen or other parts of the hammer mill instead of against the grinding plate or by suspension grinding.

Also in prior hammer mills of the type set forth, the control for increasing or decreasing the feed to the hammer mill has been positioned at the hammer mill which as has been explained above is often positioned away from the feed and bagging stations which may be on different

floors. Furthermore, the control of the feed has been manually operated and often is changed only with difficulty during actual grinding.

Accordingly, it is an important object of the present invention to provide an improved hammer mill of the suspension grinding type and particularly improved feed and control mechanisms therefor.

Still another object of the present invention is to provide an improved feed mechanism for hammer mills of the type set forth in which the grinding plate forms a part of the major feed control mechanism, the grinding plate being adjustable from a substantially fully closed to a fully opened position; more specifically, it is an important object of the invention to provide a feed control mechanism of the type set forth which is electrically operated from a remote control station and is easily changed and operated during the grinding operation.

Yet another object of the present invention is to provide in a hammer mill of the type set forth a feed control whereby the position of the grinding plate with respect to the ends of the hammers in operation is adjustable whereby to achieve varying degrees of fineness of grinding; in connection with this object it is more particularly an object to provide an electrically controlled mechanism for adjusting the degree of fineness of grinding in hammer mills of the type set forth, the degree of fineness being indicated and controlled at a point remote from the hammer mill and being fully adjustable during the grinding operation.

Still another object of the invention is to provide in hammer mills of the type set forth provided with the feed control mechanisms specified limit means to prevent injury to the hammer mill or the feed control mechanism when approaching the fully opened or the fully closed positions of the feed control mechanism.

Yet another object of the present invention is to provide in hammer mills of the type set forth an auxiliary supply of air for the pneumatic conveying systems used in conjunction therewith which supplies adequate amounts of air for operation of the conveying system in all positions of the feed control mechanism, the supply of air being arranged so that it does not interfere with proper passage of the material to be ground past the grinding plate.

Still another object of the invention is to provide in hammer mills of the type set forth an improved control mechanism for the feed whereby the rate of feed is adjusted in coordination with the fineness of feed so that maximum rated output of the prime mover for the hammer mill is utilized during the grinding operation, means being provided in addition to indicate when the prime mover for the hammer mill is operating at optimum efficiency.

A further object of the invention is to provide an improved suspension type hammer mill of the type set forth in which the rate of feed of the material to be ground and the space between the grinding plate and the tips of the hammers in operation can be adjusted interdependently so that all the material to be ground is ground to the desired fineness in one passage around the hammer mill from the feed input to the screen leading to the output from the hammer mill to provide substantially "one pass" grinding thereby making it unnecessary to change grinding screens when making large changes in the fineness of the ground material.

A still further object of the invention is to provide a hammer mill which assures a granular grind using positive suspension grinding in which hay and other roughages are ground uniformly without variance in particle size and without the formation of "strings."

These and other objects and advantages will be better understood from the following description when taken

in conjunction with the accompanying drawings. In the drawings wherein like reference numerals have been utilized to designate like parts throughout:

Figure 1 is a diagrammatical view in vertical section through a mill incorporating a hammer mill made in accordance with and embodying the principles of the present invention;

Figure 2 is an enlarged view partly in section of the installation of Figure 1 substantially as seen in the direction of the arrows along the line 2—2 of Figure 1;

Figure 3 is a further enlarged view in vertical section with certain parts broken away through the hammer mill of Figure 2 substantially as seen in the direction of the arrows along the line 3—3 of Figure 2;

Figure 4 is a rear elevational view with certain parts broken away of the hammer mill shown in Figure 3;

Figure 5 is an enlarged view in vertical section substantially as seen in the direction of the arrows along the line 5—5 of Figure 4;

Figure 6 is a view in vertical section substantially as seen in the direction of the arrows along the line 6—6 of Figure 5; and

Figure 7 is a view in horizontal section substantially as seen in the direction of the arrows along the line 7—7 of Figure 6.

Referring to Figure 1 of the drawings, there is shown a typical grinding mill installation utilizing a hammer mill generally designated by the numeral 10 made in accordance with and incorporating the principles of the present invention. Hammer mill 10 is shown installed upon a basement floor 12 and is provided with a chute 14 leading upwardly to a dump sink 16 communicating with an aperture 18 which is preferably at ground level and outside of the building wall 20. Preferably the controls for hammer mill 10 are positioned above the work floor 22 which is substantially at the same elevation as the ground. It will be seen that by this arrangement the material to be ground can be dumped through opening 18 into the sink 16 from ground level and that the operation of mill 10 can be controlled from the work floor 22 which is also at ground level.

It is to be understood that hammer mill 10 can be used in cooperation with other systems for storing and conveying the material to be ground thereto. For example, instead of the dump sink and chute illustrated, a chute for hay and the like can be used in combination with a drag for grain, ear corn, and the like. Alternatively, a hopper and feeder can be used which discharge onto a mill feed table connecting with the hammer mill 10 or a fixed chute can be used to feed material onto a mill feed table cooperating with hammer mill 10. Accordingly, it is to be understood that the present invention is not limited to the specific mill installation shown in the drawings.

The hammer mill 10 and the source of motive power therefor are mounted upon a hollow frame 24. More specifically, a pair of angle irons 26 and 28 (see Figure 3) are riveted as by rivets 30 to flanges on the frame 24 and angle irons 26 and 28 are in turn welded as at 32 to a collector 34 which forms part of the support framework for hammer mill 10 and also serves to collect the ground material which has passed through the hammer mill 10. Collector 34 is substantially rectangular in plan section and in transverse section tapers downwardly to form a chute 36 which collects the ground material and deposits it into the inlet to a pipe 38 (see Figure 2). Pipe 38 is part of a pneumatic conveying system which conveys the ground material upwardly to a point where it is collected and separated from the mass of conveying air for delivery to an output point. Preferably the outlet for the ground material from the pneumatic conveying system is at a point remote from the hammer mill 10 and usually is above the work floor 22. The outlet for the ground material may be a bagger or a pipe leading to a storage facility or to a truck for transportation to a storage facility. Further description of the pneumatic conveying system will be given later.

Formed on the upper edges of collector 34 are inturned flanges 40 and 42 which support a screen 44 of the usual type employed in hammer mills. Screen 44 is part-circular in shape and is formed on a radius such that it conforms to the path which hammers in the hammer mill follow during the grinding operation. A pair of outturned flanges 46 and 48 are provided on the upper edges of screen 44 to overlie collector flanges 40 and 42 whereby to support the screen 44 thereon. Screen 44 extends substantially the entire length of collector 34.

Mounted above collector 34 is a movable upper hammer mill housing 50 which rests upon and is supported by the collector 34. More specifically, housing 50 has a length substantially equal to the length of collector 34 but is slightly narrower as is seen in Figure 3 at the point of which it rests upon collector 34 and screen 44. The lower end of housing 50 is provided with a pair of outturned flanges 52 and 54 which rest upon flanges 46 and 48, respectively of screen 44 and serve to hold screen 44 in position upon flanges 40 and 42 of collector 34.

Housing 50 also includes a substantially vertically disposed rear wall 56 which at its upper end is curved to provide a guide wall or baffle 58 which serves to guide material to be ground to the hammers at certain positions of the feed control mechanism. The ends of housing 50 are closed by two side plates 60 which are suitably secured to rear wall 56 and are shaped to conform to baffle 58 at the upper ends thereof. A short baffle or forward wall 62 is also provided, wall 62 being curved concentric with the path of travel of the ends of the hammers and spaced outwardly therefrom.

The entire housing 50 is mounted to swing forwardly or to the left as viewed in Figure 3. More specifically, a pair of brackets 64 is mounted upon collector 34 on the front side thereof and support a shaft 66. A pair of hinges 68 is fixedly attached to the side plates 60 and the hinges 68 are pivotal about shaft 66. In order to hold housing 50 in operative position upon collector 34, an adjustable clamp is provided. The clamp includes an arm 70 fixedly attached to rear wall 56 and carrying thereon an adjustable stop 72. Engaging the upper end of stop 72 is an eccentric cam surface 74 formed integral with a handle 76 and pivotal about a pin 78. Pin 78 is carried by a pair of links 80 which in turn are pivoted on collector 34 about a pin 82. With the handle 76 in the position shown in Figures 3 and 4, cam surfaces 74 serve to lock the housing 50 in operative position upon collector 34. Movement of handle 76 in a clockwise direction as viewed in Figure 3 disengages cam surfaces 74 from stops 72 and permits the entire housing 50 to be pivoted about shaft 66 to the left and in a counterclockwise direction as viewed in Figure 3. When housing 50 is in the upper or open position, screen 44 can be readily removed and replaced. A pair of blocks 84 and 86 are carried by rear wall 56 and front wall 62, respectively, and aid in holding screen 44 in position when housing 50 is closed.

A pair of brackets 88 are mounted on the ends of collector 34 and support a pair of pillow block bearings 90 which are bolted thereto as by bolts 92 and rotatably support the main shaft 94. Main shaft 94 carries a plurality of plates 96 upon which are mounted hammers 98 by means of rods 100. Hammers 98 are free to rotate about rods 100 and with respect to plates 96. Accordingly, hammers 98 are in the position illustrated in Figure 3 only when shaft 94 is being turned at a relatively high rate. With hammers 98 in the position shown in

Figure 3, the hammers serve to grind and comminute material that falls in the path thereof.

Motive power to rotate shaft **94** is derived form an electrical motor **102** (see Figure 2) which is mounted upon the frame **24** by a plurality of bolts **104**. Motor **102** has been illustrated as a three phase motor powered from a plurality of lines **106** which connect through a control and starter box **108** to a suitable source of electrical power. Operation of motor **102** is controlled by handle **110** on control box **108** and the power consumed by motor **102** is indicated on a meter **112**.

The output of motor **102** appears on a shaft **114** which is connected by a universal joint **116** to the main shaft **94**. A shield **118** extends around the universal joint **116** to prevent injury to the operator by contact therewith. Also positioned around the portion of shaft **94** outside of the hammer mill proper, is a brake **120** operable by a handle **122** so that rotation of shaft **94** and associated parts can be stopped as desired.

Shaft **94** also extends outwardly from the left hand side of the hammer mill as viewed in Figure 2 and drives a fan **124** which moves the air stream in the pneumatic conveying system. The pipe **38** described above carries the ground material from the hammer mill to fan **124** and fan **124** discharges into a delivery pipe **126** which carries the air stream and the ground material suspended therein to the point of disposal.

Material to be ground is fed down chute **14** to a hopper **128** which feeds directly into housing **50**. Referring more particularly to Figure 3, it will be seen that hopper **128** includes a bottom wall **130** which extends downwardly to the upper edge of front wall **62**. Formed integral with bottom wall **130** is a pair of side walls **132** and **134** which are joined by a top wall **136**. Extending downwardly from side walls **134** adjacent the lower edge of bottom wall **130** is a pair of ears **138** which receive a rod **140** therethrough. Rod **140** extends through a hollow pipe **142** which is suitably secured as by welding to a curved plate **144** which is adjustably positioned upon front wall **62**. More specifically, front wall **62** has welded thereto a stud **146** which extends through an elongated aperture in plate **144**. A nut **148** threadedly engages stud **146** to hold plate **144** in adjusted position upon front wall **62**. In this manner the lower or discharge edge of bottom wall **130** can be adjusted in position with respect to the upper edge of front wall **62**.

Additional means is provided to connect hopper **128** to housing **50** in the form of a plurality of angle iron pieces which are bolted together. More specifically, a pair of angle iron members **150** are secured to the side walls **60** as by welding and an angle iron member **152** connecting with angle iron members **150** is welded along the forward edge of guide wall **58**. A flange **154** which cooperates with angle iron members **150—152** is suitably secured to hopper **128** by means of an attachment member **156** which is secured to hopper **128** by a plurality of nuts and bolts **160**. A plurality of bolts **162** interconnect flange **154** with the abutting flanges on angle iron members **150** and **152**.

Since the hopper **128** is fixedly attached to housing **50**, it is necessary that hopper **128** pivot about shaft **66** with housing **50**. To this end a pair of arms **164** is provided, one end of the arms **164** being pivoted about shaft **66** and the other ends being connected by pins **166** to flanges **168** that are secured as by welding to hopper **128**. By this construction hopper **128** pivots about shaft **66** with housing **50**.

In order to achieve suspension grinding in the hammer mill **10**, a grinding plate **170** is provided adjacent the hammers **98** and in the path of the material to be ground descending from hopper **128**. Plate **170** extends substantially the entire length of housing **50** and extends substantially vertically and parallel to the rear wall **56**. A threaded shaft **172** is fixedly attached as by welding to a mounting plate **174** which is in turn secured to the grinding plate **170** (see Figure 5). Also mounted upon plates **170** and **174** is a curved baffle **176** which extends upwardly above grinding plate **170** and is curved substantially to conform to the shape of the guide portion **58** of housing **50**. Baffle **176**, plate **174** and grinding plate **170** are interconnected by a plurality of studs **178** affixed to baffle **176** and extending through aligned apertures in plates **170** and **174** and cooperating with nuts **180**.

In order to obtain control over the rate of feed of material to be ground from hopper **128**, the position of baffle **176** and grinding plate **170** with respect to the discharge end of hopper **128** is adjustable to provide a feed inlet for material to be ground which is adjustable in size. In addition, the distance of the lower end of grinding plate **170** from the tips of hammers **98** or the arc of the throw of the hammers is adjustable whereby to obtain adjustability in the degree of fineness of grind of the hammer mill.

To these ends a pair of arcuate tracks is provided by cutting arcuate openings of the desired shape in side plates **60**. Welded to the edges of the arcuate openings are track members **182** and **184** which are U-shaped in cross section and conform to the shape of the arcuate openings. Suitably secured as by welding to the rear of grinding plate **170** is a hollow pipe **186** which receives therethrough a shaft **188**. The ends of shaft **188** extend outwardly beyond side plates **60** and into track members **182** and **184** to be guided thereby. As may be seen in Figure 3, the track members **182—184** extend from rear wall **56** to the upper edge of front wall **62**.

Movement of grinding plate **170** along track members **182—184** is accomplished and controlled by a mechanism which will now be described. Referring to Figure 5, it will be seen that the threaded shaft **172** extends through an aperture **190** in rear wall **56** and engages a nut sleeve **192** which has the left hand end thereof threaded whereby threadedly to engage shaft **172** and the right hand thereof formed smooth to provide a guide for shaft **172**. Nut sleeve **192** is in turn rotatably received by a bearing block **194**. A first bearing washer **196** is provided between bearing block **194** and a shoulder **198** formed on nut sleeve **192** and a second bearing washer **200** bears against the opposite face of bearing block **194** between bearing block **194** and a bevel gear **202** which is fixed to nut sleeve **192** by a set screw **204**. By the above described arrangement nut sleeve **192** can be rotated with respect to bearing block **194** and shaft **172** whereby to move shaft **172** and attached parts including grinding plate **170** toward and away from bearing block **194** and rear wall **56**.

Power for driving bevel gear **202** whereby to move shaft **172** and grinding plate **170** is derived from an electric motor **206** (see Figures 1 to 4). Motor **206** drives a gear reducing mechanism **208**, the output of which drives a universal connection **210**. Universal connection **210** in turn drives a shaft **212** (see Figure 5) which is journaled in a plate **214** fixedly secured to bearing block **194** as by welding at point **216**. Motor **206** and gear reducing mechanism **208** are likewise mounted upon plate **214** by a housing member **218**.

Shaft **212** is held in proper position upon plate **214** by means of a collar **220** fixedly attached to shaft **212** by a set screw **222**. A washer **224** is positioned beneath plate **214** around shaft **212** and above a second bevel gear **226** which meshes with bevel gear **202** described above. Bevel gear **226** is keyed to shaft **212** and is secured thereto by a screw **228** and a washer **230**. By this described arrangement the electric motor **206** serves to drive the bevel gears **202** and **226** which in turn rotate the nut sleeve **192**. Rotation of nut sleeve **192** within bearing block **194** moves threaded shaft **172** to the right or to the left as viewed in Figure 5 depending upon the direction of rotation of drive motor **206**. Movement of shaft **172** to the left or to the right as viewed in Figure

5 carries with it the grinding plate 170 and attached parts.

Since the grinding plate 170 moves along an arcuate path in traveling from rear wall 76 toward the entrance to chute 128, it is necessary that shaft 172 and attached parts be capable of moving to accommodate this motion. To this end bearing block 194 is formed and mounted so that it can pivot about a horizontal axis as viewed in Figures 5 and 6. More specifically, bearing block 194 is provided with a pair of pivot ears 232 and 234 which are formed integral therewith and extend laterally therefrom. Ear 232 is received in an aperture in a triangular flange 236 and pivot ear 234 is similarly received in an aperture in a triangular flange 238. Flange 236 has formed integral therewith and at right angles thereto a flange 240. Flange 240 is securely fastened as by bolts 242 and nuts 244 to a plate 246 which is U-shaped in vertical section as seen in Figure 5 and has two rearwardly extending legs 248 and 250 which are suitably secured as by welding to rear wall 56. Flange 238 is provided with a right angular integral flange 252 which is secured by bolts 254 and nuts 256 to plate 246. In order to provide lubrication between nut sleeve 192 and bearing block 194, the pivot ears 232 and 234 are provided with lubrication fittings 258 which communicate with lubricating channels 260 formed in bearing block 194.

It is desirable to make the mounting for bearing block 194 substantially air tight and to provide adjustable means which can be tightened about bearing block 194 as the various parts become worn. To this end the upper and lower sides of bearing block 194 are rounded as at 262 and 264 to cooperate with the edges of plate 246 through which bearing block 194 extends. Furthermore, there is attached to plate 246 above bearing block 194 a sealing member 266 having a sealing flange 268 bearing against the upper surface 262 of bearing block 194. A bolt 268 extends through an elongated aperture 270 in sealing member 266 and threadedly engages plate 248 whereby adjustably to position sealing flange 268 on bearing block 194.

The rounded surface 264 on bearing block 194 rests upon a sealing flange 272 which is mounted upon plate 246 by a bolt 274 passing through an elongated aperture 276 in an attachment flange 278. In this manner the sealing flange 272 can be adjusted against the curved surface 264 on bearing block 194.

In order further to provide for air tightness around the mounting for bearing block 194, the edges of plate 246 are closed by side plates 280 and 282 which are welded at their forward ends to rear plate 56 and at their rear ends to plate 246. The shape of plates 280 and 282 is such as completely to enclose the area bounded by rear wall 56, plate 246 and flanges 248—250. From the above described construction it will be seen that motor 206 and the mechanism interconnecting motor 206 and nut sleeve 192 are all mounted upon bearing block 194 whereby to move with grinding plate 170.

Referring particularly to Figure 3, the precise configuration of track members 182 and 184 will be described in detail. The right hand end 284 of track 184 as seen in Figure 3 is substantially horizontal. With grinding plate 170 positioned as shown in solid lines in this figure, the maximum rate of feed of material to be ground from hopper 128 to the hammers 98 is obtained. The lower edge of grinding plate 170 is spaced sufficiently far from the ends of hammers 98 and the arc of the throw thereof so that a minimum of suspension grinding is obtained.

The left hand end of track portion 284 joins the curved portion of track 184 at a point 286 and track 184 is curved from point 286 to the left hand thereof to provide a curved section 288. The left hand end 290 of curved track portion 288 is positioned such that the lower edge of grinding plate 170 is positioned approximately 1/8 inch away from the arc of the throw of the ends of hammers 98 when the hammers 98 are in operative position as shown in Figure 3. Curved portion 288 of track 184 gradually curves outwardly away from the arc of throw of the ends of hammers 98 so that the spacing between the lower edge of grinding plate 170 increases from the distance of 1/8 inch at point 290 to a distance of approximately 1/2 inch at point 286 on track 184. By this construction the fineness of grind of the material fed into the hammers 98 can be adjusted by adjusting the position of plate 170 along track 184.

Grinding plate 170 together with baffle 176 forms a control of the size of the feed inlet for the feed of material to be ground from hopper 128 into the hammers 98. With baffle 176 and feed plate 170 positioned as shown by dotted lines in Figure 3, the feed inlet is substantially closed and feed of the material to be ground to hammers 98 is effectively stopped. As feed plate 170 and baffle 176 are moved to the right toward the position shown by solid lines, the rate of feed is progressively increased until a maximum rate is obtained when the parts are in the position shown in solid lines.

It is desirable to control the position of grinding plate 170 at a point remote from the hammer mill and preferably from the work floor 22 and at a position adjacent the controls for the main motor 102. To this end the connections to control motor 206 such as the connections 292 pass upwardly through work floor 22 to junction box 294 (see Figure 1). Connected to junction box 294 by leads 296 is a control box 298. Control box 298 has positioned thereon a stop button 300, a close button 302 and an open button 304. Also associated with the button 302 is an indicator light 306 which is lighted when the grinding plate 170 is moved to the fully closed position as shown in dotted lines in Figure 3. Another indicator light 308 is provided below the open button 304. Light 308 is energized when grinding plate 170 arrives at the fully opened position which is illustrated by the solid line position of the parts as seen in Figure 3. When it is desired to decrease the rate of feed to the hammers 98, close button 302 is pushed and when the desired rate of feed has been obtained, the stop button 300 is pushed. Closure of switch button 302 energizes motor 206 and causes operation thereof in a direction to move grinding plate 170 to the left as seen in Figure 3. Conversely when it is desired to increase the rate of feed to the hammers 98, the open button 304 is pushed to cause motor 206 to operate in the opposite direction. This moves grinding plate 107 to the right as seen in Figure 3. When grinding plate 170 arrives at a position corresponding to the desired rate of feed, stop button 300 is pushed.

In order to prevent injury to the various moving parts when grinding plate 170 reaches the fully closed or the fully opened position, means is provided to deenergize motor 206 automatically when the grinding plate 170 is in either the opened or closed position. To this end a housing 310 is secured to housing 218 and carries therein a cam engageable with a switch. The cam is carried by a shaft 312 which has mounted thereon a sprocket 314 cooperating with chain 316. Chain 316 engages a sprocket on a shaft forming a part of the universal couplings 210 so that operation of motor 206 turns shaft 312 and the cam attached thereto. The switch engaged by the cam on shaft 312 when in engagement with the cam opens the circuit to motor 206 whereby to stop rotation thereof. The cam on shaft 312 engages and opens the switch when grinding plate 170 reaches the fully closed position of the feed inlet and when it reaches the fully opened position of the feed inlet.

Shaft 312 also carries the rotor of a position selsyn which is also positioned within housing 310. The information from the selsyn is conveyed by lines 318 to another selsyn mechanism generally designated by the numeral 320 which is positioned adjacent the control box

298 (see Figure 1). Selsyn 320 has an indicator 322 which cooperates with a dial 324 to indicate the position of grinding plate 170 along the track members 182—184. By this arrangement the position of grinding plate 170 can be accurately determined and adjusted at a point remote from the hammer mill such as above the work floor 22.

In order to insure that sufficient air is supplied to the pneumatic conveying system to form the air stream carrying the ground material through delivery pipe 126, an additional source of air is provided, the amount of air supplied by the additional source being substantially independent of the position of grinding plate 170 and baffle 176. To this end housing 50 has formed in the curved guide wall 58 thereof an aperture 326 which extends substantially the width of housing 50. Positioned over aperture 326 is a screen 328 received in guides 330. Screen 328 removes any large particles from the air drawn through aperture 326. In addition a curved and downwardly directed shield 332 is provided over screen 328 and extends the entire length thereof as can be best seen in Figure 4. Air drawn through screen 328 into aperture 326 is carried downwardly behind baffle 170 and to the grinding chamber around hammers 98. The flow of air through this path is not obstructed by material being fed to the hammers 98 and the amount of air being drawn in through this path is substantially independent of the position of baffle 176 within housing 50. The air flows downwardly through screen 44 carrying the ground material therewith, into pipe 38 and fan 124 to form a part of the air stream to convey the ground material upwardly through delivery pipe 126.

The operation of the hammer mill including the feed mechanism and the controls therefor will now be described in detail. Preferably at the end of a grinding operation the grinding plate 170 and baffle 176 are moved toward the forward or closed position of the feed inlet illustrated in dotted lines in Figure 3 of the drawings by pushing the close switch 302 (see Figure 1). When the grinding plate 170 arrives at the fully closed position, the limit switch within housing 310 will be engaged by the cam on shaft 312 to deenergize motor 206. Simultaneously the closed position indicating light 306 will be energized.

The next batch of material to be ground is then admitted into the sink 16 and flows downwardly to fill hopper 128 and comes against the baffle 176. Motor control handle 110 is then moved to the "on" position to energize the main drive motor 102. This begins rotation of shaft 94 and places hammers 98 in operative grinding condition. With the controls in these positions, the indicator 322 will indicate the closed position upon scale 324 and meter 112 will indicate a low power input to the main drive motor 102.

Grinding is commenced by closing the open switch 304 thereby energizing motor 206 and causing operation of the gear train leading to nut sleeve 192 (see Figure 5). Rotation of nut sleeve 192 with respect to bearing block 194 moves shaft 172 to the right as shown in Figure 3 whereby gradually to increase the feed opening from hopper 128 into the hammers 98. When the grinding plate 170 reaches the desired position as indicated by the position of pointer 322, stop switch 300 is pushed to deenergize motor 206. This stops movement of grinding plate 170.

The above described operation admits material to be ground to the path of hammers 98 and the material is ground substantially by suspension grinding as it falls from the grinding plate 170. The ground material passes around with hammers 98 and falls through screen 44. Air passing from hopper 128 and through screen 328 form an air stream which carries the ground material through the pipe 38 under the urging of fan 134 and upwardly into the delivery pipe 126.

Alternatively the position of the grinding plate 170 can be positioned so as to obtain the maximum rated output from motor 102. When it is desired to operate according to these conditions, the grinding plate 170 and baffle 176 are initially moved to the fully closed position. The open switch 304 is then pushed to cause operation of motor 206 to move grinding plate 170 to the right or toward the open position as viewed in Figure 3. The operator meanwhile observes the position of the needle on meter 112. When meter 112 indicates that motor 102 is operating at full rated capacity, the stop button 300 is pushed to stop movement of grinding plate 170 by deenergizing motor 206.

Modern stock feeding practices require a variety of feeds of different fineness of grind for various purposes. For example, in grinding hog feed small grain is preferably ground to a fineness such that it will pass through a ⅛ inch screen. Shelled corn for chicken feed is ground until it can pass through a ¼ inch screen. On the other hand when grinding for dairy animals, ear corn and small grain is usually ground together so that the product can pass through a ½ inch screen. When grinding for steers, however, the mixture of ear corn and small grains is ground to a fineness such that it will pass through a ¾ inch or 1 inch screen. Roughages are preferably ground so that they will pass through a 9/64 inch screen while alfalfa meal may be ground to the same fineness as roughages or up to a coarseness so that it will pass through a 1 or 1¼ inch screen for feeding steers. In custom grinding it is not always possible to arrange the grinding schedule so that all feeds to be ground to a certain fineness can be ground at one time. The degree of fineness of grinding must be changed for a new set of feeds. Furthermore, prior hammer mills have necessitated the changing of the screen such as screen 44 in the drawings for each new degree of fineness desired. Changing of the screen 44 is time consuming and unproductive particularly when the main controls are positioned at a distance from the hammer mill and on a different floor as illustrated in Figure 1 of the present drawings.

An important feature of the present invention lies in the fact that a wide range of fineness of grinding can be achieved using a single screen 44. For example, with a ⅜ inch screen, feed can be ground from a fineness of ⅛ inch to ⅜ inch. Similarly using a ½ inch screen for screen 44, a fineness of grind from ¼ inch to ½ inch can be achieved. This important feature results in the fact that the position of the lower edge of grinding plate 170 with respect to the tips of the hammers 98 can be adjusted by moving plate 170 along the track members 182—184. As has been explained above the lower edge of grinding plate 170 is positioned ⅛ inch from the ends of hammers 98 when plate 170 is in the fully closed position as illustrated by dotted lines in Figure 3 of the drawings. The distance between the lower edge of plate 170 and the ends of hammers 98 progressively increases from ⅛ inch to ½ inch as plate 170 is moved from the fully closed position to point 286 on track members 182—184. It has been found that the degree of fineness of grind can be controlled effectively by positioning the lower edge of grinding plate 170 with respect to the ends of hammers 98. In general, the closer the lower edge of plate 170 is to the edge of hammers 98, the finer is the grind, and vice versa.

Accordingly, scale 324 can also be calibrated to indicate the fineness of grind as well as the position of plate 170 along track members 182—184. The hammer mill described by suspension grinding grinds substantially all of the material being fed thereto at the first or initial pass so that by the time the material to be ground reaches screen 44 it has been ground to the desired fineness. For these reasons screen 44 is not used solely to form a trap for unground material and accordingly, finer grinds can be achieved although coarser screens 44 are utilized. This feature eliminates considerable waste effort

in changing the screen 44 when the fineness of grind is changed. The operator need only push the closed or open switches 302—304 until the indicator 322 is at the desired point on scale 324. When indicator 322 reaches the desired point on scale 324, the stop button 300 is pushed to interrupt operation of motor 206 and stop movement of grinding plate 170. The machine is then in condition to grind the material to the set degree of fineness without changing screen 44, provided screen 44 is at least as large as the set degree of fineness.

It will be seen that there has been provided a hammer mill including a feed mechanism and controls therefor which fulfills all of the objects and advantages set forth above. Although a preferred form of the invention has been shown for purposes of illustration, it is to be understood that various changes and modifications can be made therein without departing from the spirit and scope of the invention. Accordingly, the invention is to be limited only as set forth in the following claims.

We claim:

1. A hammer mill comprising a set of rotating hammers, a prime mover to rotate said hammers, a material feed inlet to said mill to feed material to be ground to the arc of the throw to said hammers, a grinding plate mounted adjacent said arc and movable therealong, a baffle mounted adjacent said grinding plate and extending upwardly into said feed inlet, said grinding plate and baffle being movable to a position substantially to close said feed inlet and to a position fully to open said feed inlet, means to position said baffle and said grinding plate with respect to said feed inlet and to position the edge of said grinding plate adjacent said arc toward and away from said arc to adjust the degree of fineness of grind, said edge moving away from said arc along an arcuate path as said grinding plate is moved from the position closing said feed inlet to the fully opened position, an air inlet to said hammer mill positioned on the side of said baffle opposite said feed inlet to permit air to flow downwardly along said baffle and said grinding plate and to the area around said hammers while separated from the material to be ground in said feed inlet, control means for said positioning means adapted to be positioned at a point spaced from said hammer mill, limit means for said positioning means to render said positioning means inoperative when said grinding plate is in the fully closed and the fully opened position, power output indicating means for said prime mover, and position indicating means for said grinding plate to indicate the position of said grinding plate with respect to said feed inlet and the arc of the throw of said hammers.

2. A hammer mill comprising a set of rotating hammers, a material feed inlet at the top of the mill to feed material to be ground into the upper arc of the throw of the hammers, and a grinding plate mounted adjacent said hammers and movable along the arc of the throw thereof, said grinding plate being movable to a position substantially to close said feed inlet and being movable to a multiplicity of positions to vary the size of said feed inlet, the position of the lower edge of said grinding plate moving gradually along an arcuate path away from the arc of the throw of said hammers as the grinding plate is moved from the position substantially closing said feed inlet to the position giving maximum size for said inlet, said lower edge being positioned approximately ⅛ inch from said arc when said grinding plate is in a position substantially to close said feed inlet and being approximately ½ inch from said arc when said grinding plate is at the point on said arcuate path nearest the fully opened position of said grinding plate.

3. A hammer mill comprising a set of rotating hammers, a material feed inlet at the top of the mill to feed material to be ground into the upper arc of the throw of the hammers, a grinding plate mounted adjacent said hammers and movable along an arcuate path adjacent thereto, electrical means to move said grinding plate from a position substantially to close said feed inlet to a position fully to open said feed inlet, the position of the lower edge of said grinding plate moving gradually along an arcuate path away from the arc of the throw of said hammers as the grinding plate is moved from the position substantially closing said feed inlet to the fully opened position of said feed inlet, and control means positioned remote from said hammer mill to control said electrical means whereby to effect movement of said grinding plate at a point remote from the hammer mill.

4. A hammer mill comprising a set of rotating hammers, a material feed inlet at the top of the mill to feed material to be ground into the upper arc of the throw of the hammers, a grinding plate mounted adjacent said hammers and movable along an arcuate path adjacent thereto, electrical means to move said grinding plate from a position substantially to close said feed inlet to a position fully to open said feed inlet, the position of the lower edge of said grinding plate moving gradually along an arcuate path away from the arc of the throw of said hammers as the grinding plate is moved from the position substantially closing said feed inlet to the fully opened position of said feed inlet, and limit means automatically to deenergize said electrical means to stop movement of said grinding plate at a predetermined distance near said arc and at a predetermined distance away from said arc.

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 23,903	Moore	Dec. 7, 1954
1,883,051	Stamets et al.	Oct. 18, 1932
2,154,503	French et al.	Apr. 18, 1939
2,291,815	Korum	Aug. 4, 1942
2,764,361	Moore	Sept. 25, 1956

OTHER REFERENCES

American Miller and Processor, January 1949, page 167.