Jan. 19, 1937. R. G. QUEHL 2,068,071

ATTRITION MILL

Filed June 10, 1932 4 Sheets-Sheet 1

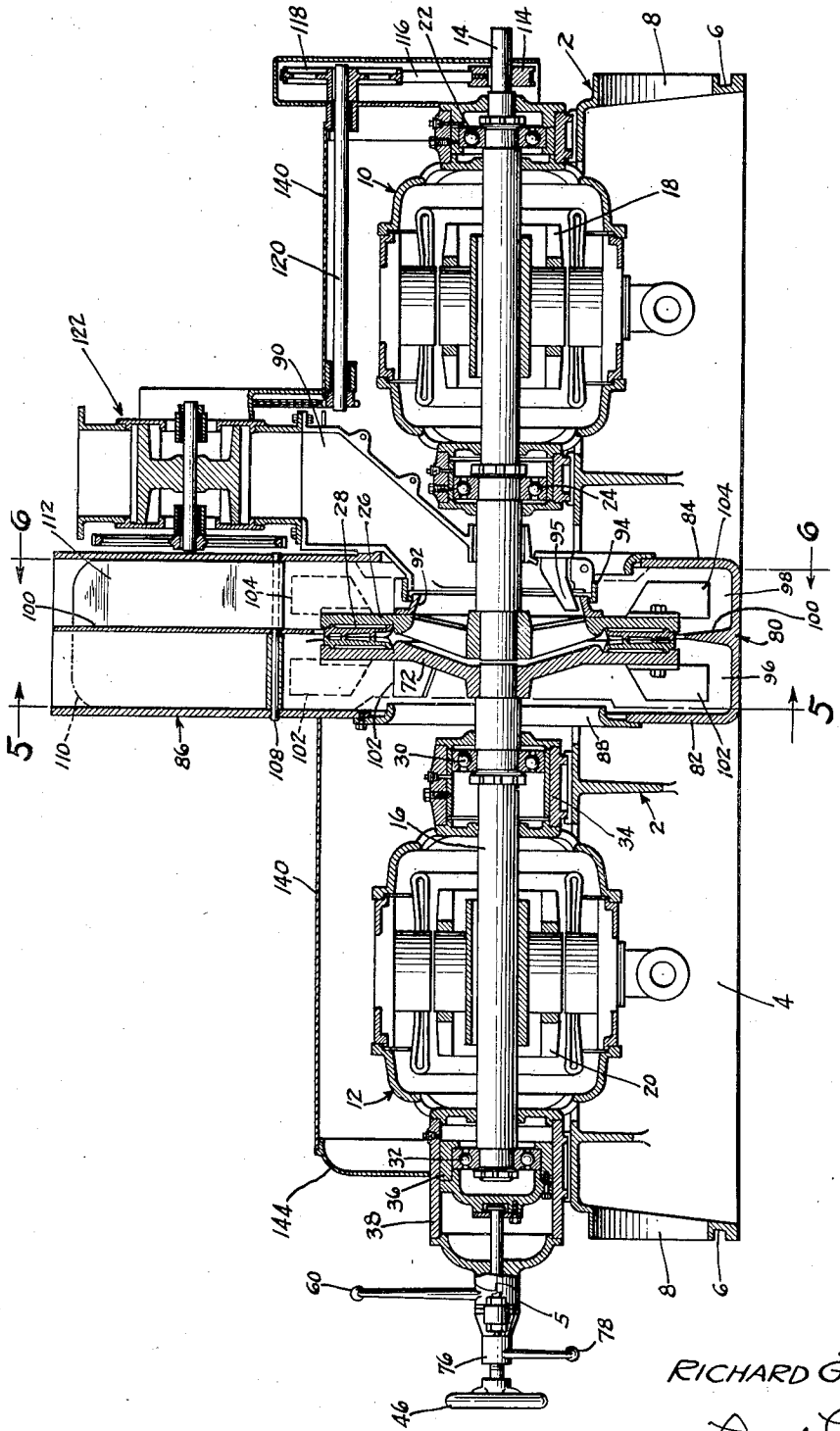


FIG. 1

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ATTRITION MILL

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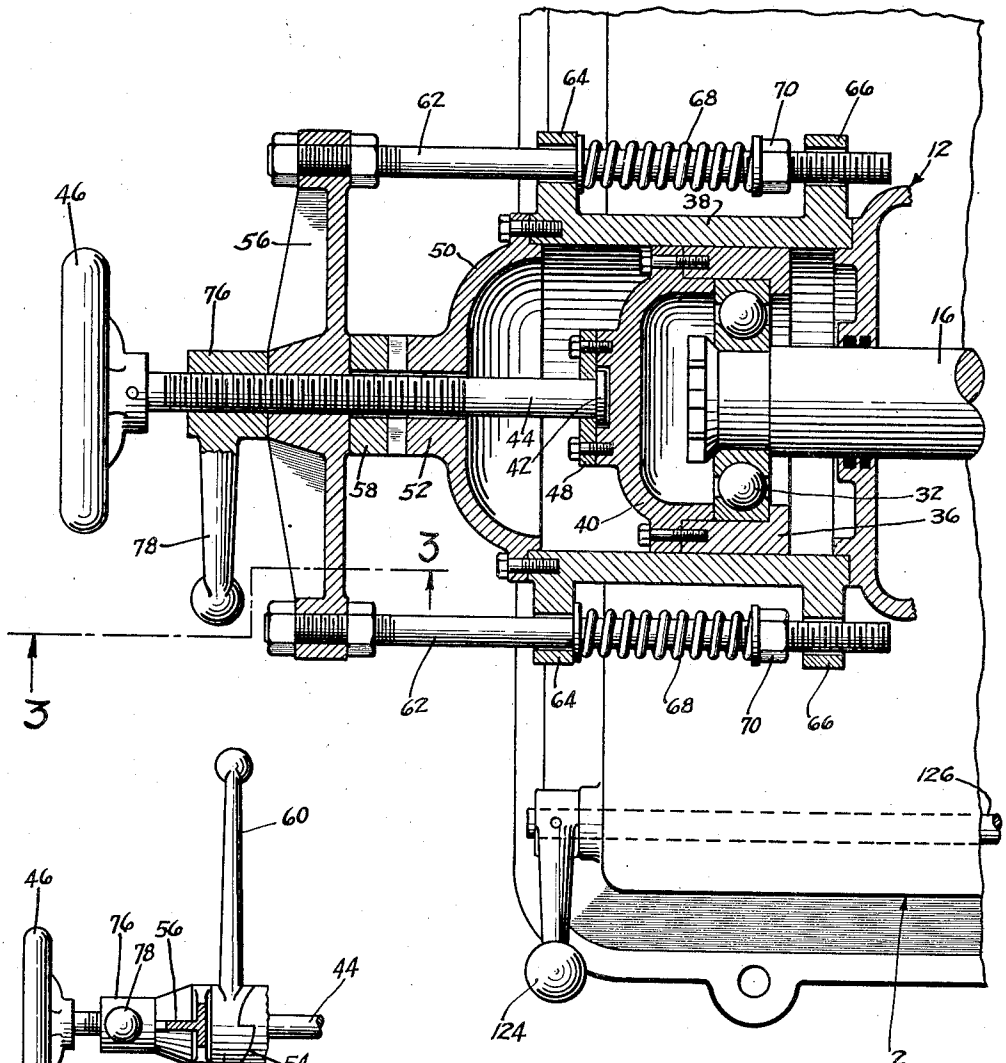


FIG. 2

FIG. 3

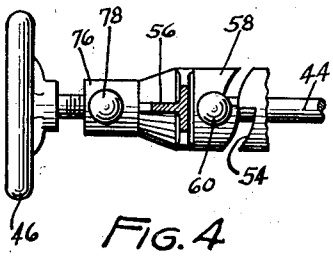


FIG. 4

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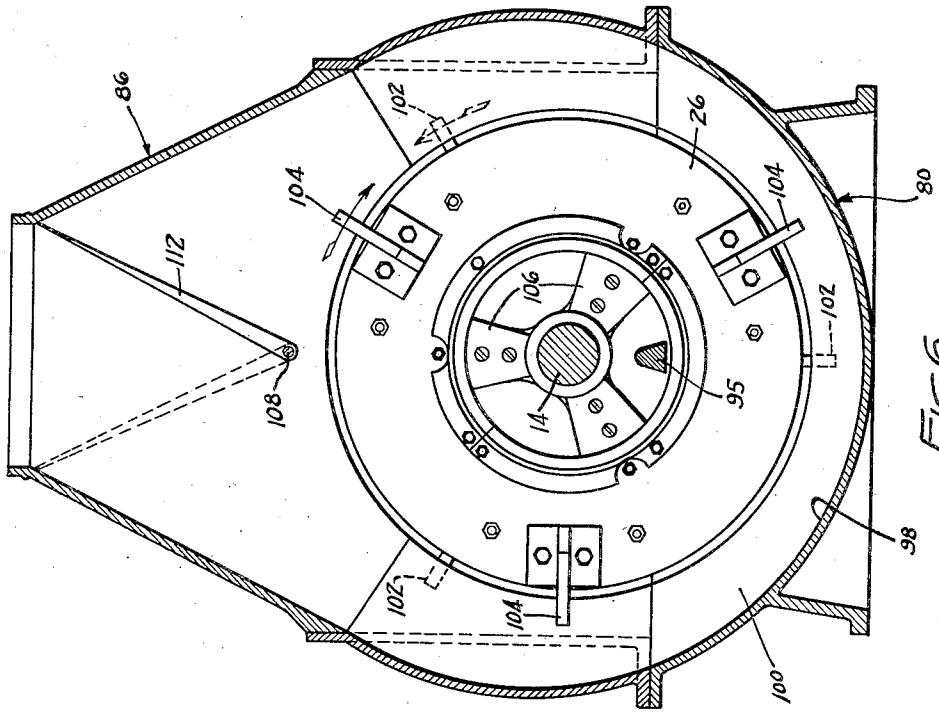


FIG. 6

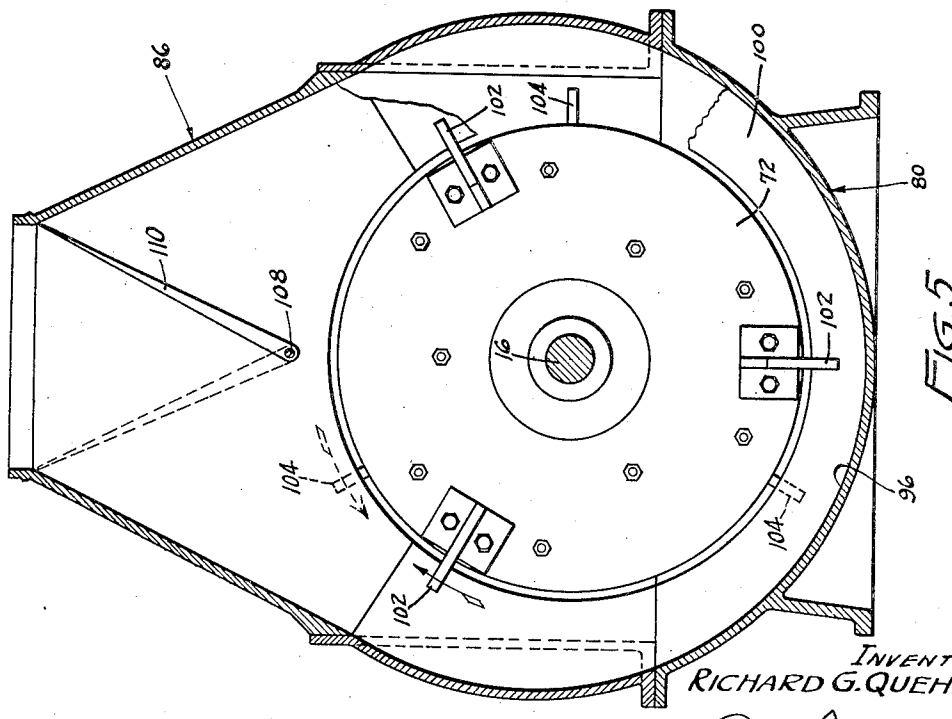


FIG. 5

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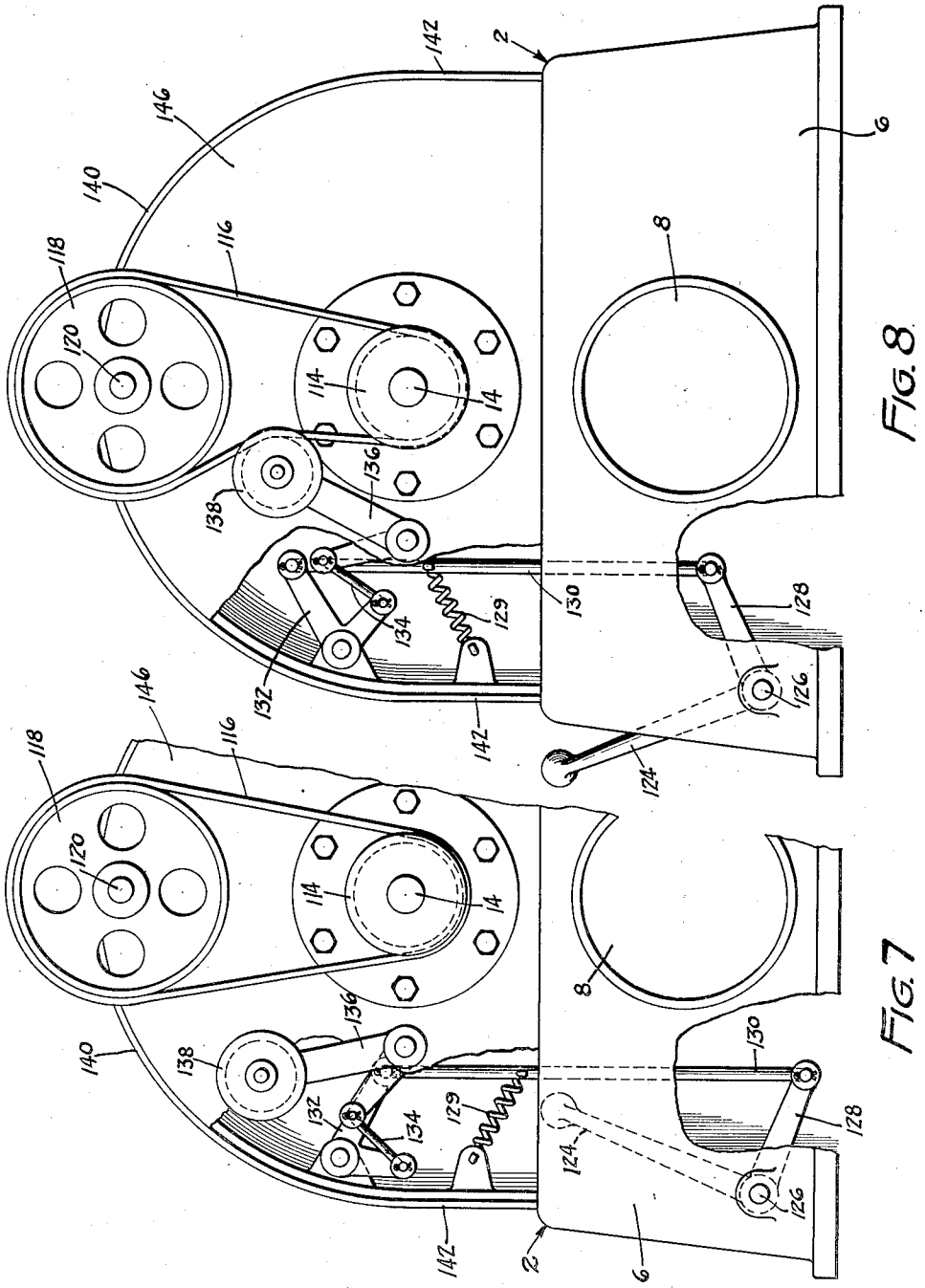


FIG. 8

FIG. 7

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UNITED STATES PATENT OFFICE

2,068,071

ATTRITION MILL

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Application June 10, 1932, Serial No. 616,484

9 Claims. (Cl. 83—8)

This invention relates to attrition mills and has for a general object the provision of an attrition mill unit which is of compact and simplified construction, is operative to grind and convey material under treatment with the expenditure of a minimum amount of power, and which will also maintain the material under treatment extremely cool.

The invention relates more particularly to that type of attrition mill having a pair of co-operating grinding plates and it is another object of the invention to provide a mill of this type wherein the elements necessary to the grinding, including the motor means, and the blower elements necessary for the conveying away of the ground material, are combined as a single unit within a single housing.

An additional feature of the invention comprises the provision of an annular wall separating the grinding casing into two compartments and the provision of a set of fan blades on each of the grinding plates, one set of said fan blades operating in one of the aforementioned compartments and the other operating in the other thereof. More specifically it is an object to provide such a mill which will be automatically reversible without mechanical change.

Other objects of the invention, which include the provision of simplified means for quickly stopping operation of the feeder when necessary and the provision of simplified means for quickly separating the attrition mill plates, will be apparent upon a detailed study of the accompanying drawings and specification when read in conjunction with the appended claims.

In the drawings, which merely illustrate one embodiment of the invention, Figure 1 is a longitudinal vertical cross section through an attrition mill embodying the features of this invention;

Figure 2 is a fragmentary enlargement showing a horizontal cross section through the mechanism for adjusting the clearance between the attrition mill plates and for quickly separating the same when necessary;

Figure 3 is a cross section along the line 3—3 of Figure 2 and shows the positions of the parts when the grinding plates are in proper relation for grinding;

Figure 4 is a view similar to Figure 3 showing the relation of the parts when the grinding plates are separated;

Figure 5 is a cross section along the line 5—5 of Figure 1;

Figure 6 is a cross section along the line 6—6 of Figure 1;

Figure 7 is a partial rear elevation with the casing partly broken away to show the mechanism for controlling the drive of the feeder, the parts being shown in position when the feeder is inoperative;

Figure 8 is a view similar to Figure 7 showing the relative positions of the parts when the feeder is operative and being driven from the shaft of one of the attrition mill motors.

Referring more particularly to the drawings, the numeral 2 designates generally a one-piece casting which constitutes a support or base for the entire attrition mill unit. This base includes two imperforate side walls 4 and a pair of end walls 6 each of which is provided with an air inlet opening 8 for a purpose later to be described. Mounted on top of the support 2 are a pair of electric motors 10 and 12 each having a shaft 14 and 16 upon which there is fixed a rotor 18 and 20, respectively. The shaft 14 is mounted for rotation in suitable ball bearings 22 and 24, each having an inner race fitting snugly in a reduced portion of the shaft. The outer race of ball bearing 22 is fixed in a suitable bearing support secured to the top of the base 2. At one end of the shaft 14 there is fixed a grinding plate 26 having the usual grinding element 28 secured thereto. Shaft 14 is not capable of longitudinal movement but is merely adapted to rotate in the position shown in Figure 2.

The shaft 16 is mounted for rotation in suitable ball bearings 30 and 32 each having an inner race fitting snugly in a reduced portion of the shaft in a manner to prevent longitudinal movement with respect thereto. The outer race of ball bearing 30 is slidable in a bearing 34 supported on top of the base 2 and the outer race of ball bearing 32 is mounted in a ring 36 which is slidable in the bearing 38, also fixed on top of the base member 2. Shaft 16 and its ball bearings are therefore longitudinally slidable as a unit.

The ring 36 has secured thereto a cap 40 by means of suitable bolts which co-operate with a shoulder formed in the ring 36 to hold ball bearing 32 against longitudinal movement with respect to this ring. The top of the cap has a recess formed therein for the reception of the enlarged head 42 of a threaded rod 44 having an operating wheel 46 fixed thereto. The stem of the rod 44 passes through an opening in a disk 48 which is secured to the cap 40 by means of suitable bolts and which retains the head 42 in the aforementioned recess. It will be ob-

served that the rod 44 and its head 42 are capable of rotation within this recess and with respect to the disk 48 but that rod 44 is incapable of longitudinal movement independently of the cap 40, and consequently of the ball bearing 32 and the shaft 16.

The outer end of the bearing 38 has bolted thereto a cap 50 which is provided centrally with a tubular extension 52 having its outer edge surfaces formed as cam surfaces as at 54. A cross member 56 is provided with an interiorly threaded opening engaging the threads formed upon the rod 44. Surrounding the rod 44 and situated between said cross member 56 and the aforementioned tubular extension 52 there is a cam member 58 having an operating handle 60 and this member is provided at its edges with cam surfaces co-operating with the surfaces 54 of the tubular extension. The cross member 56 has secured at either end a rod or bolt 62 which extends through openings provided in ears 64 and 66 formed integrally with the bearing member 38. Compression springs 68 are adjustable by means of the nuts 70 and serve to resiliently actuate the cross member 56 toward the central portion of the base member 2.

It will be observed that longitudinal movement of the cross member 56 will result in similar longitudinal movement of the shaft 16 which carries a grinding plate 72 provided with a grinding element 74 for co-operation with the grinding element 28 of the grinding plate 26. Upon rotation of the operating wheel 46 and consequent rotation of the threaded rod 44 it will be seen that the position of the grinding plate 72 with respect to the grinding plate 26 will be adjusted. When the desired adjustment is obtained it may be held by the lock nut 76 which is provided with an operating handle 78.

If some hard material should by any chance get between the grinding plates, the plate 72 will be able to give because of the resilient connection described above. In the event it should become necessary, however, to quickly separate the grinding plates it is simply necessary for the operator to rotate the operating lever 60 whereupon the cam member 58 will engage the cam surfaces 54 in a manner to push the rod 44 to the left, as will be evident from Figure 4, and consequently effect complete separation of the attrition mill plates. When normal operation is to be resumed it is simply necessary for the operator to return lever 60 to the position shown in Figure 3. This simplified and quickly operable means for effecting separation of the attrition mill plates is very useful whenever any large particles of foreign matter get between the plates, and enables separation of the same instantaneously and before any real damage is done.

The grinding plates 26 and 72 which are mounted on the ends of shafts 14 and 16 operate in a grinding casing generally designated at 80. The lower portion of this grinding casing is preferably formed integrally with the casting forming the base member 2 as will be evident from Figure 1. This grinding casing has side walls 82 and 84 and is provided adjacent its top with a discharge spout portion 86. The side wall 82 has an air inlet opening having an air guiding ring 88 secured about its edges. This ring is of course stationary and there is a large amount of clearance between the same and the shaft 16. The side wall 84 is also provided with an air inlet opening which is substantially concentric with the opening in the wall 82. An inlet conduit 90 for the material which is to be ground is formed of two similar castings bolted together, one of which is shown in Figure 1, and extends through this opening in the wall 84. The discharge end of the inlet conduit 90 lies adjacent a flanged ring 92 which is suitably bolted to the grinding plate 26 around the edges of its opening for admitting material to be ground, between the plates. A seal ring 94 prevents leakage of the material in its passage from the conduit 90 to the grinding plates and a wiper 95 which is secured to inlet conduit 90 is disposed adjacent the joint formed at the seal ring. The shaft 14 extends through an opening provided in the walls of the conduit 90 as shown in Figure 1 which may be suitably packed and it will be apparent that air may enter the grinding casing through the space between the conduit 90 and the air inlet opening in the wall 84.

The casing 80 is divided into two separate compartments 96 and 98 by means of the substantially annular wall 100 which is extended upwardly to similarly separate the discharge spout as will be evident from Figures 1, 5 and 6. This wall 100 is not precisely intermediate of the grinding plates so that substantially all of the ground material drops into compartment 96. As shown in Figures 5 and 6 this wall 100 essentially follows the outlines of the grinding casing and discharge plate and is provided with a circular opening having a diameter slightly greater than that of the grinding plates. The inner periphery of this opening lies adjacent the outer edges of the grinding plates. Each grinding plate has secured thereto on the back thereof adjacent its outer edge a set of spaced fan blades, the set on the plate 72 being designated 102 and the set on the plate 26 being designated 104.

As shown in Figure 6 the plate 26 is annular in shape and is supported upon the shaft 14 by means of a spider 106 through which the incoming material to be ground passes. A pin 108 extends transversely across the bottom of the spout portion of the grinding casing and has pivoted thereto a pair of flap members 110 and 112 which are disposed in the compartments 96 and 98 of the grinding casing, respectively. Each of these flap members may freely pivot on the pin 108 so as to assume a position inclined toward one side or other of the casing depending upon the direction of rotation of the grinding plate carrying the fan blades operating in the particular compartment in which the flap member is mounted. These flap members are automatically reversible upon reversal of the mill.

At the top of the inlet conduit 90 there is mounted a feed regulator generally designated at 122 of any desired type and this regulator is preferably driven directly from one of the shafts 14 and 16. As here shown, the shaft 14 has fixed at its outer end a pulley 114 engaged by a belt 116 also passing around a pulley 118 mounted upon a shaft 120 which drives the feed regulator 122. The belt 116 is so arranged that it will slip unless tensioned by a suitable idler. It sometimes happens in the milling process that the mill will become choked and upon the occurrence of this condition it is desirable to be able to very quickly render the feed regulator inoperative so that it will not supply any additional feed to the mill. In order to enable the operator to readily control the operation of the feed regulator there is provided at the control

end of the mill an operating lever 124 which is fixed to a rod 126 (Figure 2) which extends longitudinally of the mill adjacent to the outer end of shaft 14. The rod 126 has secured thereto a lever 128 (Figure 7) pivoted to a link 130 which is pivoted at its other end to the long arm of a bell crank lever 132. The short arm of this bell crank lever is pivoted to a link 134 which has its other end pivoted to the short arm of a bell crank lever 136. The long arm of the bell crank lever 136 carries an idler 138. Figure 8 shows the position of these parts when the idler engages the belt and the feed regulator is in driving relation with the shaft 14 and Figure 7 shows the position of the parts when the idler is disengaged from the belt so that the pulley 114 does not drive the belt and does not operate to drive the feed regulator. As will be evident from Figures 7 and 8, the parts are selectively held in operative or inoperative position by means of spring 129 which operates with a sort of snap action.

The motors, grinding casing, inlet conduit therefor, and associated parts are all enclosed in what might be termed a main casing whose lower portion is constituted by the walls 4 and 6 of the base member 2. The upper portion of the casing is preferably sectional and removable. It is substantially imperforate when assembled and fits snugly with base member 2. This upper part of the main casing has a top portion indicated at 140, side portions indicated at 142 and ends 144 and 146. It will be understood that any desired type of casing may be used so long as the motors and grinding and blowing mechanisms are substantially completely enclosed, the air inlet openings of the main casing being preferably so arranged with respect to the air inlet openings of the grinding casing that the air draft induced by the fan blades will sweep over and cool the motors.

In operation the electric motors 10 and 12 are started and serve to rotate the grinding plates 26 and 72 in opposite directions. As shown by the arrows in Figures 5 and 6, for example, the plate 72 may be rotated in clockwise direction looking from the left in which case the plate 26 would be operated in counter clockwise direction looking from the same side. If it be assumed that the plates have been properly spaced by adjustment of the operating wheel 46 and locking device 76, the operator may move the lever 124 into the position shown in Figure 8 and thus set the feed regulator 122 in operation. This regulator will supply material to the conduit 90 and it will be conducted therethrough to the spider 106 of the plate 26 through which it will pass to be ground between the grinding plates.

Inasmuch as the wall 100 is not directly intermediate of the two grinding plates substantially all of the material passing therebetween will fall into the compartment 96 of the grinding casing. The rotation of the plate 72 which has the fan blades 102 secured thereto will set up an air current through the left hand air inlet opening 8 of the base member 2 and through the opening in the wall 82 of the grinding casing. This current of air picks up the ground material and discharges it through the space between the flap member 110 and the opposite wall of the discharge spout as will be evident from Figure 5. The fan blades 104 which are fixed on the grinding plate 26 will draw air through the right hand air inlet opening 8 of the base member 2 and through the space between the inlet conduit 90 and the opening in wall 84. This flow of air will pass out of the grinding casing between the flap member 112 and the opposite wall of the discharge spout. It will serve to pick up any ground particles that may have dropped into the compartment 98 and will further serve to boost the flow of air and ground particles from the compartment 96. Due to the arrangement of the wall 100 which causes most of the ground material to drop into the compartment 96, all of the ground material is readily discharged irrespective of the fact that the compartment 98 has a smaller air inlet opening than compartment 96 because of the presence of the inlet conduit 90.

It will be seen that the air which enters through the inlet openings 8 of the main base 2 sweeps over motors 10 and 12 to cool the same and also sweeps directly against the grinding plates in order to cool these elements. Consequently the mill is very cool during operation and the milled product obtained is also of a very desirable low temperature. The power required for the grinding and for the conveying away of the ground material is much less than in other mills wherein the high degree of cooling is not present and wherein separate blower means are used for conveying the ground material.

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

1. An attrition mill including, a pair of grinding plates, a pair of electric motors driving said grinding plates in opposed directions, means for supplying material to be ground to said grinding plates, fan means for pneumatically conveying away the material ground by said plates, and a main casing, said grinding plates, electric motors and fan means being arranged together in a single combined unit enclosed within the main casing, said casing having air inlets for supplying air to said fan means, and the said motors being located in the path of air currents from said inlets to said fan means whereby the incoming air sweeps over said motors to cool the same in the course of its path to the fan means.

2. An attrition mill including a pair of grinding plates, means for driving said plates, means for supplying material to be ground to said plates, fan blades mounted upon said plates for conveying away the ground material, and a main casing enclosing said grinding plates and driving means and forming therewith a single combined unit, said casing having an air inlet opening for supplying air to said fan conveying means and the said driving means being located in the path of air currents from said inlet opening to said fan blades whereby the incoming air sweeps over said driving means to cool the same in the course of its path to the fan blades.

3. An attrition mill including a grinding casing, an annular wall separating said casing into two compartments, a pair of grinding plates mounted for operation in the opening in said annular wall, a set of fan blades secured to the back of each of said grinding plates, the set of fan blades secured to one of said grinding plates being disposed in one of the aforementioned compartments and the set of fan blades secured to the other grinding plate being disposed in the other of said compartments, means for driving said grinding plates in opposed directions, and means for supplying material to be ground to the plates, said sets of fans being operative to produce air currents for conveying away the ground material.

4. An attrition mill including a grinding cas-

ing, a pair of co-operating grinding plates mounted for rotation therein, electric motor means for driving said grinding plates in opposed directions, an annular wall having its inner periphery adjacent the outer edges of said grinding plates and separating said grinding casing into two compartments, a plurality of fan blades secured to one of said grinding plates and disposed within one of the aforementioned compartments, a plurality of additional fan blades secured to the other of said grinding plates and disposed in the other of said compartments, a discharge spout formed at the upper portion of said grinding casing, and means for feeding material to be ground to said grinding plates, each of the compartments of said grinding casing having an air inlet opening and said fan blades being adapted upon rotation during operation of the mill to induce a flow of air through these openings for pneumatically conveying away the ground material through the discharge spout.

5. An attrition mill including a grinding casing, a pair of co-operating grinding plates mounted for rotation within said casing, means for driving said grinding plates in opposite directions, an annular wall having its inner periphery adjacent the outer edges of said grinding plates and separating the grinding casing into two compartments, a set of fan blades secured to the back of one of said grinding plates adjacent its outer edge and located within one of said compartments, a second set of fan blades secured to the back of the other of said grinding plates and being located in the other of said compartments, a discharge spout formed at the upper part of said grinding casing, a wall dividing said discharge spout into compartments forming continuations of said grinding casing compartments, a pair of flap members each pivoted in one of the compartments of said spout portion and being arranged to incline toward either side of the spout depending upon the direction of rotation of the fan blades operated in its particular compartment, and means for feeding material to be ground to said grinding plates, said grinding casing having air inlet openings through which currents of air are induced by said fan blades during operation of the mill to convey away the ground material, said flap members being operated to automatically pivot from one side to the other of the discharge spout upon reversal of the direction of operation of the mill, whereby said mill is automatically reversible without mechanical change.

6. An attrition mill including a grinding casing, a pair of co-operating grinding plates arranged for rotation within the same, an annular wall having its inner periphery adjacent the outer edges of said grinding plates and dividing the grinding casing into a first and a second compartment, a conduit for conveying material to be ground to said grinding plates and extending through said first compartment, said annular wall being so arranged with respect to said grinding plates that substantially all of the ground material drops from between the plates to the said second compartment, a first set of fan blades secured to the back of one of said grinding plates and being disposed in the first compartment, a second set of fan blades secured to the back of the other grinding plate and being disposed in the second compartment, and means for driving said grinding plates, each of the compartments of said grinding casing having an air inlet opening through which a flow of air is established by the action of the aforementioned sets of fans during operation of the mill, the flow of air induced by the set of fan blades operating in the second compartment being adapted to pneumatically convey away substantially all the ground material and the flow of air induced by the fan blades operating in the first compartment being adapted to boost the first mentioned flow of air.

7. An attrition mill including a grinding casing, a pair of co-operating grinding plates mounted for rotation within said casing, means for rotating the grinding plates, an annular wall having its inner periphery adjacent the outer edges of the grinding plates and separating the grinding casing into two compartments, a conduit extending through one of said compartments for conveying material to be ground to said grinding plates, a discharge spout portion formed at the upper part of said grinding casing, a wall separating said spout portion into compartments forming continuations of the aforementioned compartments of the main portion of the grinding casing, a pair of automatically reversible flap members each pivoted in one of the compartments of said spout portion, a set of fan blades mounted on the back of one of said grinding plates and located in one of said compartments, and a second set of fan blades mounted on the back of the other of said grinding plates and located in the other of said compartments, the aforementioned annular wall being so arranged with respect to said grinding plates that substantially all of the ground material drops into the compartment other than the one through which the conduit for incoming material extends, each of the compartments of said grinding casing being provided with air inlet openings wherethrough the aforementioned sets of fans set up currents of air for pneumatically conveying away the ground material during the operation of the mill.

8. An attrition mill comprising a grinding casing, a first grinding plate mounted for rotation within said casing, fan members secured to the back of said first grinding plate, an electric motor for driving the same, a second grinding plate arranged for rotation within the grinding casing and co-operating with said first mentioned grinding plate, a second electric motor for driving the same, a second set of fan blades secured to the back of the same, an annular wall having its inner periphery adjacent the outer edges of said grinding plates and dividing the grinding casing into a first compartment in which the fan blades on the first grinding plate are disposed and a second compartment in which the fan blades on the second grinding plate are disposed, said annular wall being so arranged with respect to the grinding plates that substantially all of the ground material drops into said second compartment, a conduit for incoming material to be ground extending through said first compartment, and a main casing having air inlet openings and enclosing said motors and grinding casing, said first compartment having an air inlet opening about the edges of said inlet conduit and said second compartment having an air inlet opening directly opposite said second grinding plate, said sets of fan blades being operable to induce air currents through said inlet openings for pneumatically conveying away the ground material, the air inlet openings of the main casing being so arranged with respect to the air inlet openings of the grinding casing that the air currents flowing therebetween are caused

to sweep over and cool the electric motors which drive the grinding plates.

9. In an attrition mill, a grinding casing formed with a discharge spout, grinding elements disposed in the casing, means for selectively rotating one of the elements in either direction, fan blades fixed on the rotating grinding element for creating a discharge blast, means for feeding material to be ground to the grinding elements, and a movable deflection element disposed in the discharge spout, said deflector being movable between a first position in which it cooperates with the spout walls to form a substantially tangential discharge passageway for the ground material when said rotatable element is rotating in one direction and a second position in which it cooperates with the spout walls to form a substantially tangential discharge passageway for the ground material when the rotating plate is rotating in the opposite direction.

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