Oct. 29, 1935. W. A. SEYMOUR 2,019,274

APPARATUS FOR FEEDING MATERIALS TO GRINDING MILLS

Filed Dec. 16, 1931 2 Sheets-Sheet 1

Fig. 1.

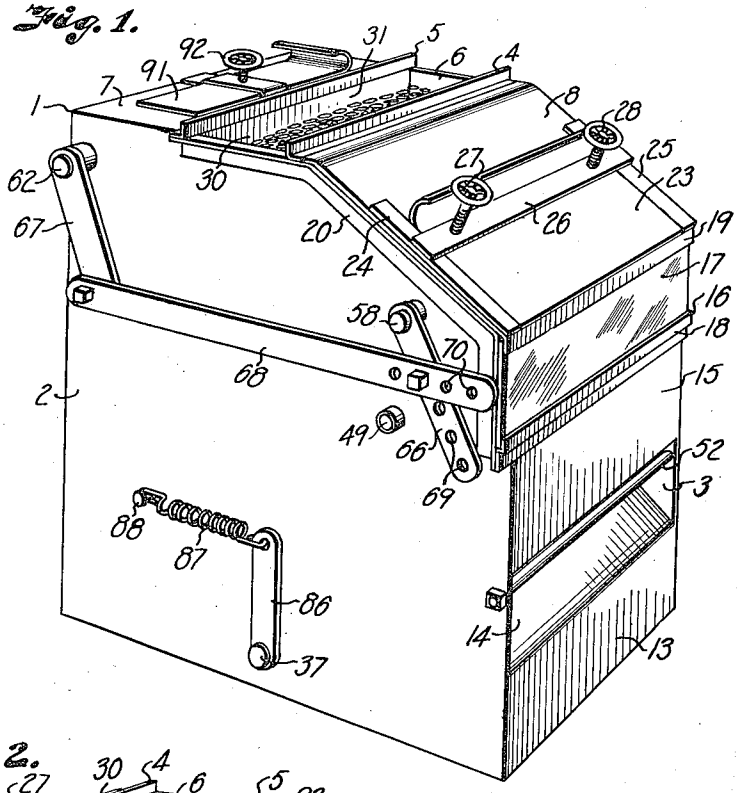


Fig. 2.

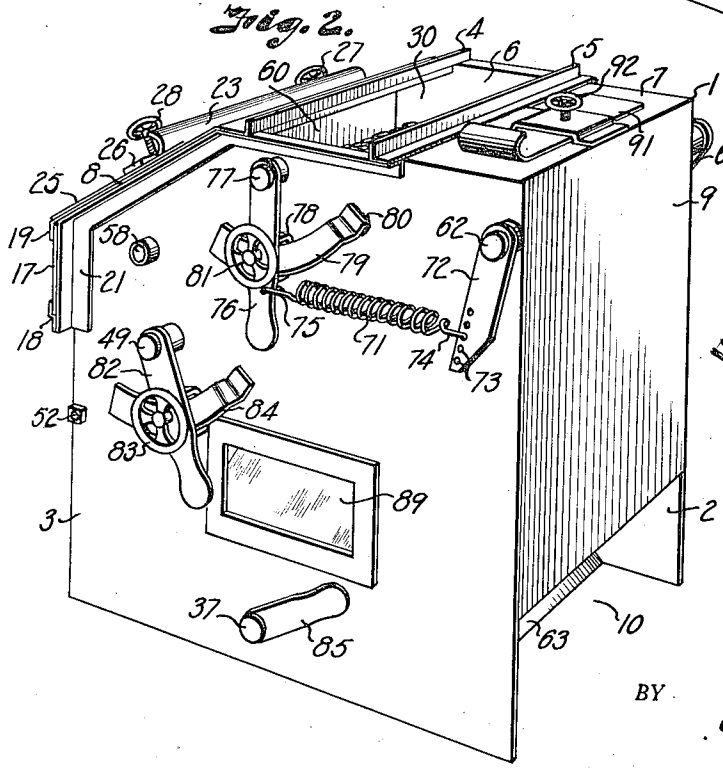
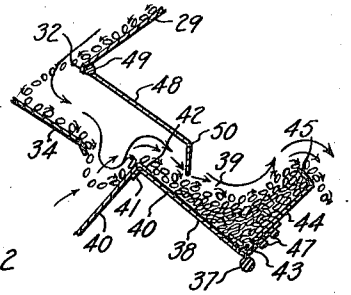


Fig. 3.



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Fig. 3.

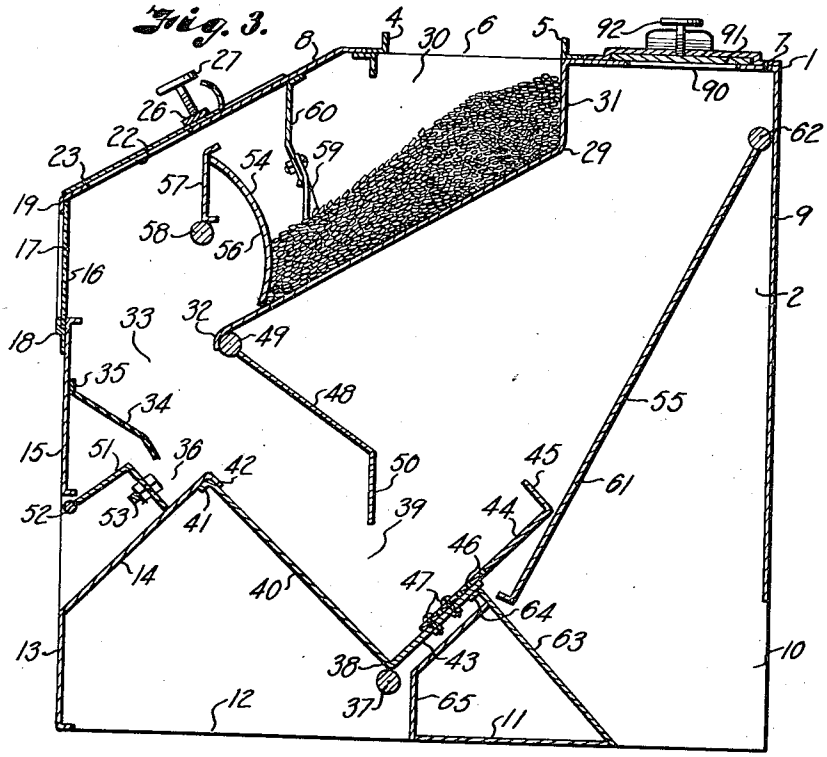
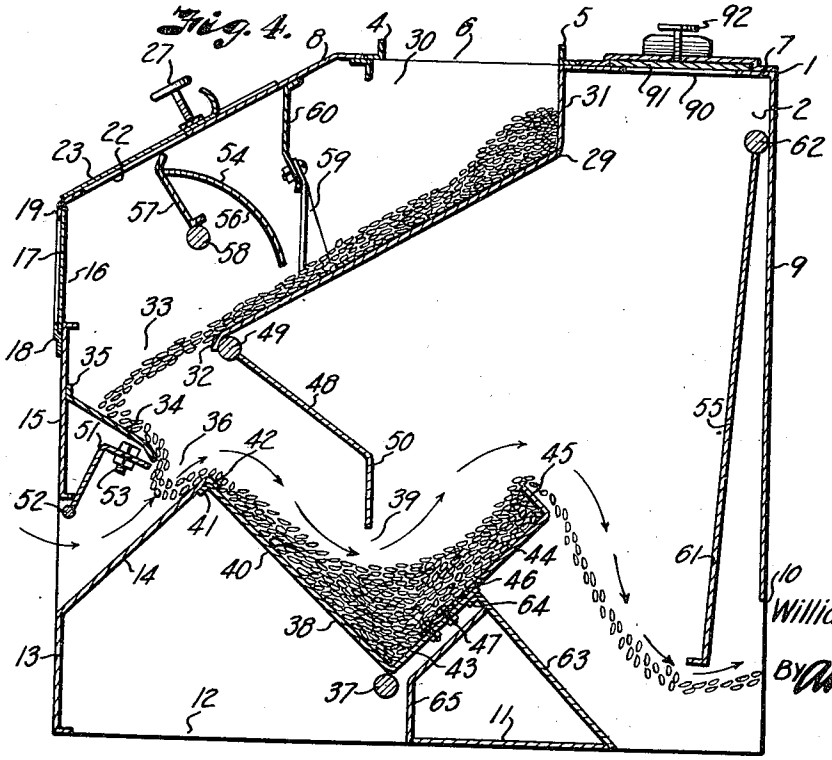


Fig. 4.



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UNITED STATES PATENT OFFICE

2,019,274

APPARATUS FOR FEEDING MATERIALS TO GRINDING MILLS

William A. Seymour, Leavenworth, Kans.

Application December 16, 1931, Serial No. 581,330

19 Claims. (Cl. 83—44)

This invention relates to an apparatus for feeding materials to grinding mills and particularly to those of that type wherein a current of air passes through the mill, and has for its principal object to automatically govern the volume of the material to maintain a constant uniform load on the prime mover operating the mill.

It is also an object of the invention to remove foreign particles from the material being delivered to the mill.

In the accomplishing these and other objects of the invention, I have provided improved details of structure, the preferred form of which is illustrated in the accompanying drawings, wherein:

Fig. 1 is a perspective view of a combination feeder and separator constructed in accordance with my invention.

Fig. 2 is a similar view of the feeder and separator viewed from the side opposite that shown in Fig. 1.

Fig. 3 is a longitudinal vertical sectional view through the machine, illustrating the air and grain feed control valves in closed position, or the position they assume when the mill is not operating.

Fig. 4 is a similar view showing the various control valves in open position and illustrating the passage of the grain as it is delivered to a milling machine.

Fig. 5 is a diagrammatic view of the rolling action of the grain as it moves through the roll chamber.

Referring more in detail to the drawings:

1 designates a housing including substantially rectangular shaped side plates 2 and 3 having their forward upper corners sheared off to provide inclined shelf portions for a purpose later described. The upper ends of the side plates 2 and 3 are connected by angle members 4 and 5 which are inset from the corners thereof and spaced apart to form an inlet opening 6 therebetween. Also connecting the opposite upper ends of the side plates is a horizontal plate 7 and an inclined plate 8 to close the spaces on the opposite sides of the angle members 4 and 5. The rear edges of the side plates are connected by a wall plate 9, connecting with the rear edge of the plate 7 but terminating short of the lower edges of the side plates to form the upper portion of a grain outlet opening 10.

Extending across the bottom of the housing and spaced from the rear corners thereof is a horizontal plate 11 separating the bottom into a forwardly positioned opening 12 and defining the opposite side of the outlet 10 through which the material, such as grain, is discharged into a grinding mill (not shown).

Connecting the lower front corners of the side plates and defining the front edge of the opening 12 is a plate 13 having an inwardly directed, upwardly inclined portion 14 forming a chute for discharging foreign objects as later described. Spaced above the chute but terminating short of the upper edges of the side plates is a plate 15 whose upper edge forms the lower edge of a window opening 16 that is closed by a shatter proof transparent panel 17 having its lower edge mounted in a strip 18 fixed to the plate 15 and its upper edge engages under a depending flange 19 on the forward edge of the inclined plate 8. Extending along the edges of the side plates from a point below the window 16 to the rear angle member 5 are angles 20 and 21 to which the ends of the panel 17, plate 8 and angle members 4 and 5 are attached.

Formed in the plate 8 is a rectangular-shaped opening 22 adapted to be closed by a slide valve 23 operating between side bars 24 and 25 fixed to the plate 8 above the angle members 20 and 21. Extending across the side bars 24 and 25 is a cross bar 26 having clamp screws 27 and 28 for retaining the valve plate in adjusted position, as later described.

Extending downwardly below the angle member 5 and between the side plates is an inclined plate 29 which cooperates with the plate 8 and side plates 2 and 3 to provide a feeding chamber 30 from which the grain flows, as later described. The upper end 31 of the plate 29 extends vertically of the housing and connects with the front edge of the plate 7, while the lower end 32 of the plate terminates short of the end plate 15 to provide an outlet opening 33 through which the grain gravitates to the separating part of the machine now described.

Extending across the path of grain discharged through the opening 33 is a downwardly inclined guide 34 having its upper edge 35 secured to the plate 15 and its lower edge terminating short of the inclined plate 14 to form an air inlet opening 36 through which the air that supplies the mill is drawn.

Rotatably mounted in the side plates 2 and 3 substantially on the median line thereof and adjacent their lower edges is a rock shaft 37, and welded to this shaft is a trough-shaped pocket member 38 forming the bottom of the roll chamber 39. The member 38 includes a forwardly and upwardly extending plate portion 40

having a lateral flange 41 at its free end to engage under a stop flange 42 on the free end of the plate 14, and a rear portion 43 that extends at substantially right angles to the portion 40 in an upwardly and rearwardly direction from the shaft 37.

Adjustably bolted to the upper face of the portion 43 is an extension plate 44 having a right angularly projecting flange 45 for controlling the height of grain carried in the trough portion of the member 38, as later described, the extension being provided with a series of apertures 46 which may align with similar opening in the portion 43 of the member 38. Bolts 47 are extended through selected ones of the openings to secure the plates together.

In order to control the travel of the grain through the roll chamber, as later described, I provide a control damper 48 that is fixed to a shaft 49 rotatably mounted in the side plates adjacent the terminal of the plate 29, as best illustrated in Figs. 3 and 4. The damper 48 extends rearwardly and terminates in a depending flange 50 that cooperates with the trough member to form a tortuous path for air and grain traveling through the roll chamber.

The velocity of the air admitted through the opening 36 is automatically controlled by an L-shaped valve 51 fixed to a shaft 52 that is rotatably mounted in the side plates 2 and 3 at a point directly below the plate 15, as is shown in Figs. 2 and 4. The valve 51 is provided with a bolt 53 whereby counter-weights may be attached for weighting the valve to operate at air pressures to give the desired velocity and volume.

In order to automatically control the amount of grain gravitating form the feed chamber directly proportionate to the amperage load on the motor running the mill, I provide a feed valve 54 actuated by an air controlled diaphragm 55 now described. The feed control valve comprises an arcuate shaped plate 56 extending entirely across the housing between the side plates 2 and 3 and having its lower edge normally engaging against the upper face of the inclined plate 29 to shut off flow of grain from gravitating to the separating chamber. The upper edge of the arcuate valve plate is welded to an arm 57 extending from a rock shaft 58 that is rotatably mounted in the side plates 2 and 3.

In order to thicken the flow of grain passing the valve 54 so that its movements are not as critical as where the stream is relatively shallow, the sides of the stream of grain are drawn together by spaced guide plates 59 supported at the sides of the feed chamber 30 in front of the valve by a cross plate 60.

The diaphragm 55 comprises a plate 61 narrower than the width of the housing to provide space between the side edges thereof, and the housing wider than the size of material being fed to prevent such material from lodging therebetween and prevent actuation of the diaphragm. The upper end of the plate 61 is fixed to a shaft 62 that is rotatably mounted in the upper rear corners of the side plates 2 and 3, and its lower end projects downwardly between the side plates and abuts against the free end of the extension 44, as illustrated in Fig. 3.

In order to close off the space between the lower end of the diaphragm 55 and the rear edge of the plate 11, I provide an inclined plate 63 which is welded to the sides of the housing and extends from the rear edge of the plate 11 to engage the trough member 38, where it is provided with a lateral flange 64 to form a stop against which the portion 43 of the trough rests.

The space between the upper edge of the plate 63 and the forward edge of the plate 11 is closed by a complementary plate 65 welded to the forward edge of the plate 11 and the under face of the plate 63 at a point below its flange 64, as is clearly shown in Figs. 3 and 4.

In order that the valve 54 and diaphragm 55 may be operated in synchronism, the ends of the shafts 58 and 62 projecting through the side plate 2 are provided with depending lever arms 66 and 67 having their ends connected by a link 68. This last named arm may be provided with a series of openings 69 whereby the pivotal connection of the connecting link may be adjusted to vary the relative degree of movement between the valve and diaphragm.

The connecting link 68 is also provided with a series of openings 70 whereby the spacing between the arms 66 and 67 may be adjusted to properly position the valve 54 and the diaphragm 55.

In order that the movement of the diaphragm 55 may be set to operate at a predetermined air pressure, which pressure is proportionate to the amperage load on the motor, I provide a spring 71 having variable tension for normally retaining the diaphragm in closed position, as now described.

Fixed to the end of the shaft 62 projecting through the side plate 3 is an arm 72 having a series of openings 73 into which one end 74 of the spring 71 may be hooked, as shown in Fig. 2. The opposite end 75 of the spring 71 is hooked to an actuating lever 76 pivoted to a stud 77 projecting from the face of the plate 3. The lever 76 is provided with a guide 78 on its rear face that is movable over an arcuate quadrant 79 having one end welded to the side plate of the housing as at 80. Carried by the lever 76 is a clamping screw 81 for drawing the guide 78 into engagement with the quadrant to retain the lever in adjusted position and maintain the proper degree of tension on the spring 71.

The air control valve 48 is operated by a lever 82 fixed to the projecting end of the shaft 49 and which is retained in adjusted position by a clamping screw 83 and a quadrant 84 similar to the quadrant 79 and adjusting screw for the lever 76.

The shaft 37 may be rotated to swing the trough member 38 downwardly through the opening 12 to dump the material separated therein by a lever 85 mounted on one end of the shaft 37. The opposite end of the shaft 37 carries a lever 86 to which is connected a spring 87 having its opposite end anchored to a stud 88 on the housing for yieldingly retaining the trough member in normal position, as shown in Figs. 3 and 4.

The side of the housing in alignment with the trough member 38 may be provided with a window 89 through which the rolling action of the grain may be observed as it passes through the separating chamber.

When the velocity of the air admitted through the opening 36 is too great, additional air may be admitted through an opening 90 provided in the plate 7, which opening is normally closed by a plate 91 clamped in position over the opening by a clamp screw 92. This air bypassing the roll chamber is admitted directly past the diaphragm 55.

In operating a device constructed and assembled as described, the connecting link 68 is ad-

justed to position the feed valve 54 in closed position and the diaphragm 55 abutting against the extension 44 on the member 38. The motor operating the milling machine is then started. Operation of the milling machine then creates a vacuum to draw the valve 51 into open position to allow air to be drawn through the opening 36 and through the roll chamber into the mill. As the volume of the air increases it actuates the diaphragm 55 to open the feed valve 54, allowing the grain to gravitate off the end 32 of the plate 29 onto the plate 34 where it changes its direction of travel and gravitates down the plate and across the path of air drawn through the opening 33. At this point the grain is caught by the air current and is elevated over the end of the plate 14. The grain then gravitates by rolling down the plate 40 to pile up in the pocket formed at the bottom thereof until it reaches a point where the air stream begins to again pick up the grain kernels to roll them upwardly over the grain kernels trapped in the pocket and over the flange 45, as shown in Fig. 4, from where the kernels continue gravitational feed into the mill through the opening 10.

The clamping screw 81 will then be loosened and the spring 71 tensioned to exert sufficient resistance on the diaphragm 55 to maintain the volume of grain delivered to the milling machine at a rate governed by the amperage load on the motor, whereby the mill may be kept operating at its most efficient speed.

This adjustment may be readily made by watching the ammeter in the motor circuit. The lever 76 may be adjusted until the ammeter shows the load desired, after which the lever may be locked in place. The machine will then automatically retain its load from then on, because, should the machine tend to choke up, the spring 71 will move the diaphragm to shut off the feed valve proportionate to the reduction in the air stream, or, should the machine increase its speed, the increased air stream will actuate the diaphragm to increase the feed of the grain.

Foreign objects carried by the grain will not be picked up by the air stream as they drop on the plate 14 but will roll down the incline and be discharged from the machine. The other foreign objects that are of different shape than the grain will be rolled into the trough, as above described, and will not be carried over the flange 45 into the milling machine.

The grain progresses by a series of rolls, first by gravitation down the plate 29 and onto the plate 34, where it rolls downwardly across the air stream, which changes the direction of the kernels to roll them upwardly over the flange 42, where they again roll downwardly across the bed of grain carried in the pocket of the trough to be again caught by the air current and rolled up the inclined body of grain dammed up by the flange 45. This is very important because the rolling action of the grains and foreign bodies of irregular shapes other than the shape of the grain will cause separation of the foreign particles from the grain since the foreign particles will not rotate at the same speed and direction as the grain. Thus the rolling action of the grain crowds the foreign particles into the bed of grain to be trapped thereby.

This movement of the grain and the amount or degree of roll can be controlled by moving the air control valve 48 to and from the member 38, and by lengthening or shortening the trough through adjusting the plate 44. Should the mill not create sufficient air to lift the valve 51, the valve plate 23 may be opened to admit the proper amount of air through the opening 22. When too much air is drawn through the roll chamber, it may prevent evacuation of the foreign material. In this instance the plate 91 may be actuated to admit air through the opening 90 to provide the correct velocity of air drawn through the roll chamber.

After the machine has been in operation for some time, this foreign material may be removed by actuating the lever 85 against tension of the spring 87 to move the trough member into dumping position, whereupon the material carried therein will be discharged through the opening 12.

Attention is directed to the spacing of the plate 66 from the shaft 37 and the rear portion 43 of the pocket member so that as soon as the pocket member is starting to tilt, the suction of the mill draws a stream of air therethrough to prevent increase in velocity of the main air stream. This is important because the flow space under the member 59 is reduced incidental to dumping movement of the pocket member and would, therefore, tend to increase the velocity and carrying effect of the main air stream. This would tend to draw the foreign materials back into the housing and into the mill, but by providing the opening to the rear of the pocket member for the inlet of additional air, this is prevented.

By the rolling action of the grain through a sinusoidal path as illustrated and described, I have been able to separate not only metallic particles but also pieces of wood, stone, dirt, glass, etc., as well as grains of different shape and weight than the grains delivered to the milling machine. This separation is very desirable to not only provide a clean product but to eliminate fire hazards or explosions caused by foreign objects entering the mill. The method of controlling feed of the grain also permits operation of the mill at constant even loads, resulting in saving of power, increased capacity of the mill, and prevents burning out of the motor due to excessive loads.

What I claim and desire to secure by Letters Patent is:

1. In a device for feeding material to a mill, a housing having an air inlet and an air outlet through which a stream of air is supplied to the mill, a feed control chamber in the housing, a valve controlling feed of material from said feed control chamber, a diaphragm in the path of the air stream, and means operably connecting said feed control valve and said diaphragm whereby the diaphragm operates said feed valve responsive to said air stream.

2. In a device for feeding material to a mill, a housing having an air inlet and an air outlet through which a stream of air is supplied to the mill, a feed control chamber in the housing, a valve controlling feed of material from said feed control chamber, a diaphragm in the path of the air stream, means operably connecting said feed control valve and said diaphragm whereby the diaphragm operates said feed valve responsive to said air stream, and means for automatically controlling said air inlet to regulate velocity of the air stream.

3. In a device for feeding material to a mill, a housing having an air inlet and an air outlet through which a stream of air is supplied to the mill, a feed control chamber in the housing, a valve controlling feed of material from said feed

control chamber, a diaphragm pivotally mounted in the path of the air stream, and means operably connecting said feed control valve and said diaphragm whereby the diaphragm operates said feed valve responsive to said air stream.

4. In a device for feeding material to a mill, a housing having an air inlet and an air outlet through which a stream of air is supplied to the mill, a feed control chamber in the housing, means controlling feed of material from said chamber, a downwardly inclined member in the housing to change direction of travel of the material discharged from said chamber and across the path of the air stream, an upwardly inclined member in the housing over which the material is rolled under influence of the air stream, a second downwardly inclined member receiving the grain from the upwardly inclined member, a second upwardly inclined member receiving discharge from the second downwardly inclined member and over which the material is rolled by said air stream and discharged to said outlet, and means for controlling said air stream.

5. In a device for feeding material to a mill, a housing having an air inlet and an air outlet through which a stream of air is supplied to the mill, a feed control chamber in the housing, means controlling feed of material from said chamber, a downwardly inclined member in the housing to change direction of travel of the material discharged from said chamber and direct the material across the path of the air stream, an upwardly inclined member in the housing over which the material is rolled under influence of the air stream, a second downwardly inclined member receiving the grain from the upwardly inclined member, and a second upwardly inclined member receiving discharge from the second downwardly inclined member and over which the material is rolled by said air stream and discharged to said outlet, and means between the second downwardly inclined member and the second upwardly inclined member for controlling said air stream.

6. In a device for feeding material to a mill, a housing having an air inlet and an air outlet through which a stream of air is supplied to the mill, a feed control chamber in the housing, a valve controlling feed of material from said control chamber, a diaphragm pivotally mounted in the path of the air stream, means operably connecting said feed control valve and said diaphragm whereby the diaphragm operates said feed valve responsive to said air stream, a pocket member for supporting a body of material in the path of the air stream and in contact with material fed from said chamber to entrap foreign particles from the material, and means for pivoting said pocket member to dump the foreign material from said housing.

7. In a device of the character described for feeding material to a mill, a housing having an air inlet and an air outlet through which a stream of air is supplied to the mill, a feed control chamber in the housing, means controlling feed of material from said chamber, pressure actuated means supported in the housing in the path of the air stream passing therethrough, means operably connecting the pressure actuated means with the feed controlling means to automatically regulate the rate of feed proportional to varying pressures of said air stream, and yielding means connected with said pressure actuated means to cause said pressure actuated means to function at predetermined air pressures.

8. In a device for feeding material to a mill, a housing having an air inlet and an air outlet through which a stream of air is supplied to the mill, a feed control chamber in the housing, a valve normally controlling feed of material from said chamber, a diaphragm in the path of the air stream, means operably connecting said feed control valve with said diaphragm whereby said diaphragm operates the feed control valve responsive to said air stream, means for tensioning said diaphragm to function at predetermined air pressures, and means for adjusting the connection of the feed control valve with the diaphragm to obtain a predetermined feed at said predetermined air pressures.

9. In a device for feeding material to a mill, a housing having an air inlet and an air outlet through which a stream of air is supplied to the mill, a feed control chamber in the housing, means controlling feed of material from said chamber, a diaphragm located in the path of the air stream and operable thereby, means operably connecting the diaphragm with the feed control means, means in the housing for supporting said material for movement in a sinusoidal path by said air stream to effect diversion of foreign objects carried with the material, and a valve controlling said inlet to maintain the air stream at a fixed velocity independent of volume.

10. In a device for feeding material, a housing having an air inlet and an air outlet through which a stream of air is passed, a feed control chamber in the housing, a valve controlling feed of material from said control chamber, a diaphragm pivotally mounted in the path of the air stream, means operably connecting said control valve with said diaphragm whereby the diaphragm operates said feed valve responsive to said air stream, and a pocket member supporting a body of the material in the path of the air stream and in contact with material fed from said chamber to entrap foreign particles from the material.

11. In a device for feeding material to a mill, a housing having an air inlet and an air outlet through which a stream of air is supplied to the mill, means in the housing for gravitating material to be delivered to the mill, a downwardly inclined member in the housing to change direction of travel of the gravitating material to direct the material across the path of the air stream, an upwardly inclined member in the housing over which the material is rolled under influence of the air stream, a pocket member for containing a bed of the material, means for supporting the pocket member in the housing in the path of the rolling material to entrap foreign objects carried by the rolling material, and adjustable means supported in the housing above said bed for controlling the air stream.

12. In a device for feeding material to a mill, a housing having an air inlet and an air outlet through which a stream of air is supplied to the mill, means in the housing for gravitating material to be delivered to the mill across the path of the air stream, an upwardly inclined member in the housing over which the material crossing said air stream is rolled under influence of said air stream, a pocket member for containing a body of the material, means for supporting the pocket member in position to receive the rolling material discharged from said inclined member so that foreign objects carried with the material are rolled into the bed of material carried in the pocket member, and adjustable means supported

in the housing above said pocket member for retaining the air stream in contact with the material carried in the pocket.

13. In a device of the character described, a housing having an air inlet and an air outlet, a downwardly inclined member supported in the housing for gravitating material downwardly across and through the path of the air stream, an upwardly inclined member in the housing for receiving the gravitating material and over which the material is rolled under influence of the air stream, a second downwardly inclined member receiving the grain from the upwardly inclined member, a second upwardly inclined member receiving discharge from the second downwardly inclined member and over which the material is rolled by said air stream and discharged to said outlet, and means for controlling said air stream.

14. In a device of the character described, a housing having an air inlet and an air outlet for passing a stream of air through the housing, a feed control chamber in the housing, a valve controlling feed of material from said chamber for gravitation through said air stream at a point adjacent the air inlet, a series of inclined members in the housing projecting into the path of said air stream for intercepting the gravitating material and to form a substantially sinusoidal path over which the material is rolled under influence of said air stream, means for supporting a bed of the material in the path of the rolling material whereby foreign materials carried with the rolling material are rolled into the bed, and means responsive to pressure of the air stream for regulating said feed control means.

15. In a device of the character described, a housing having an air inlet and outlet for passing a stream of air through the housing, means in the housing for gravitating material across the air stream, an inclined member in the housing on which the material crossing said air stream is rolled under influence of said air stream, means supported in the housing for carrying a body of material in position to receive the rolling material moving across the inclined member whereby foreign objects carried with the rolling material are rolled into the bed of material, and a damper supported in the housing and having a lower edge extending directly across said bed of material to cooperate with the surface of the bed for controlling the air stream.

16. In a device of the character described, a housing through which a current of air is passed, means for gravitating material across said air stream, an inclined member in the housing below said air stream for intercepting the gravitating material passing through the air stream and over which the material is rolled under influence of the air stream, an oppositely inclined member in the housing receiving the rolling material, a damper, and means for adjustably supporting the damper for movement to and from the last-named inclined member to effect rolling movement of the material through a sinusoidal path.

17. In a device for feeding material to a mill, a housing having an air inlet and an air outlet through which a stream of air is supplied to the mill, means in the housing for gravitating material to be delivered to the mill, a downwardly inclined member in the housing to change the direction of travel of the gravitating material to direct material across the path of the air stream, an upwardly inclined member in the housing over which the material is rolled under influence of the air stream, a pocket member for containing a bed of material, means for supporting the pocket member in the housing in the path of the rolling material to entrap foreign objects carried by the rolling material, adjustable means supported in the housing above said bed for controlling the air stream, and means for dumping the pocket member to discharge the entrapped foreign objects.

18. In a device of the character described, a housing having an air inlet and an air outlet for passing a stream of air through the housing, means in the housing for gravitating a stream of grain through the air stream, a series of oppositely inclined baffle members supported in the path of the air stream to intercept the gravitating grain and to form a sinusoidal path through which the grain is rolled under propelling influence of said air stream, and means supported in the housing for retaining the air stream in close contact with the grain moving over said baffle members.

19. In a machine of the character described including a housing having an air inlet and air outlet for passing a stream of air through the housing and having an outlet for foreign materials, means in the housing for gravitating material through the air stream, a pocket member for supporting a bed of the material, means pivotally supporting the pocket member so that the air stream moves over the bed of material, means in the housing for diverting the gravitating grain for rolling movement across the bed of material under influence of the air stream to entrap foreign materials in said bed, means for dumping the pocket member to discharge the foreign materials through said outlet, and a stop plate for operating with the pocket member to close said foreign material outlet, said stop plate being spaced from the pocket member when the pocket member is in dumping position to allow entrance of a secondary air stream through said foreign material outlet.

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