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M. FRISCH
PULVERIZATION

1,990,178

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2 Sheets-Sheet 1

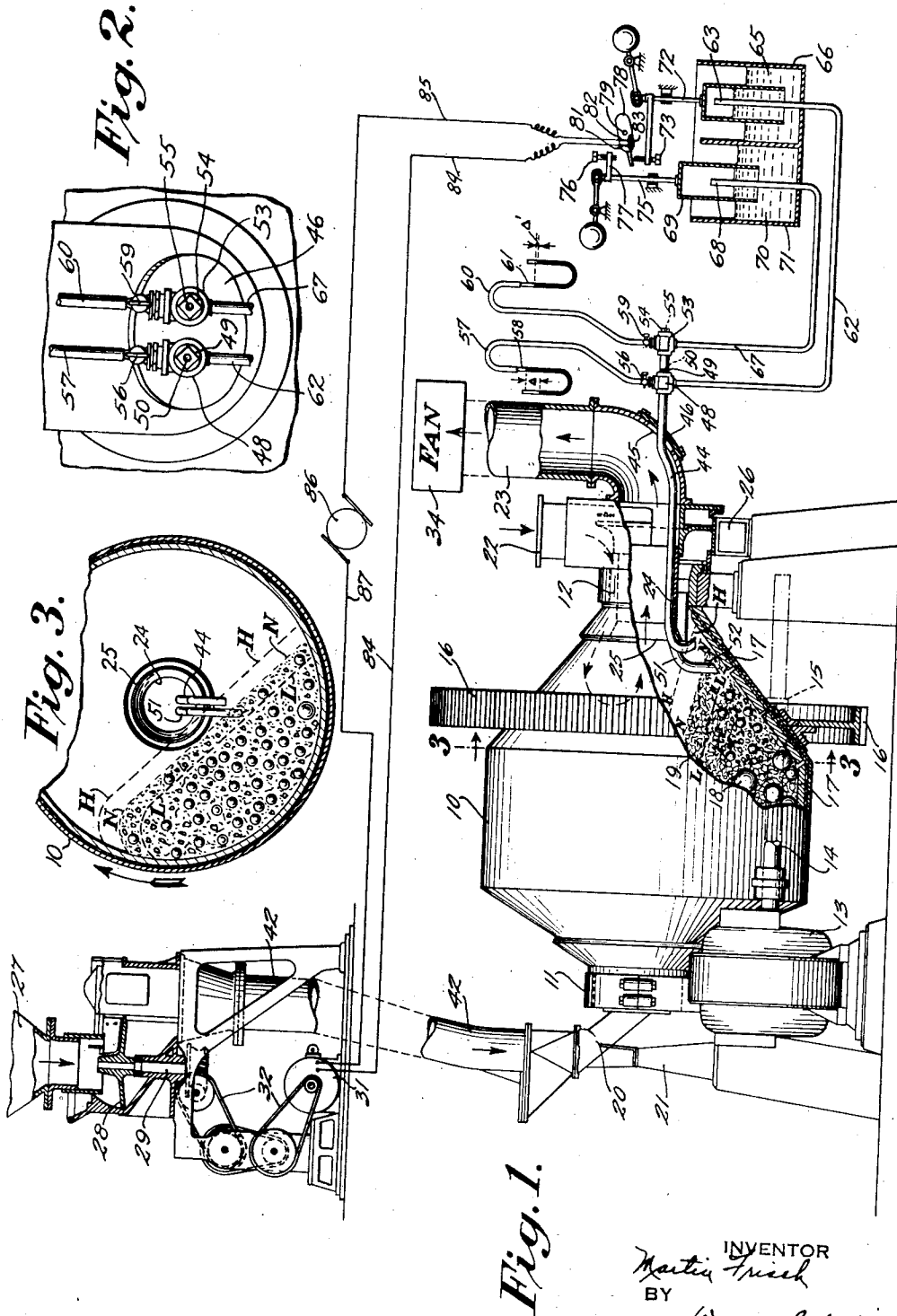


Fig. 1.

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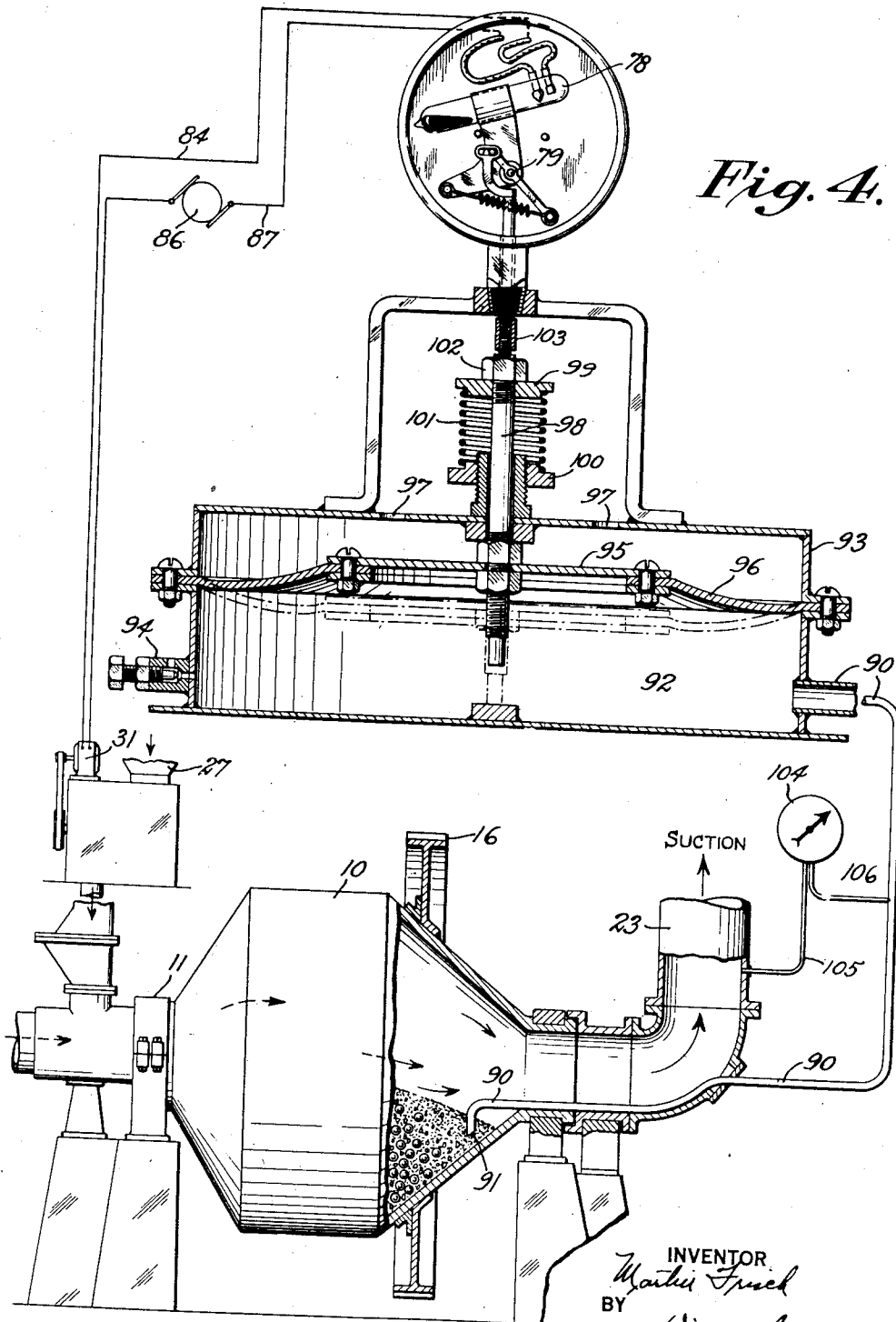
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2 Sheets-Sheet 2



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1,990,178

PULVERIZATION

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Application June 12, 1931, Serial No. 543,858

26 Claims. (Cl. 83—9)

This invention relates to fuel pulverizers such as ball mill pulverizers. More particularly the invention relates to air-swept ball mills for pulverizing coal and to apparatus for and method of indicating and controlling the charge therein.

In order to control the output and fineness of the product of ball mill pulverizers it is necessary to maintain the quantity or volume of the charge in the mill, that is to say, the amount of mixture of the product and the grinding balls (not including the powdered material suspended in the air current), substantially constant irrespective of the rate of grinding of the product. If the volume (hereinafter referred to as quantity) of the charge is permitted to increase materially above normal, the charge may spill over into one or more of the trunnions, particularly the discharge trunnion, and may restrict the opening through which the air enters the pulverizer and the connection through which the product leaves the mill. This reduces the output of the pulverizer. If the quantity of charge is permitted to fall materially below normal, there will be a deficiency of product and an excessive rate of wear of the grinding balls and the liners of the mill.

It has been the practice heretofore to judge the correctness of the quantity of charge in ball mill pulverizers by the sound produced by the mill and to control the rate at which the product was fed to the mill by hand in accordance with the sound. This has required the constant attention of experienced operators.

In accordance with the present invention, provision is made for positively indicating the quantity of the charge in ball mill pulverizers and for automatically controlling the same.

The nature of the invention will become apparent from the following description when considered in connection with the accompanying drawings forming a part thereof and in which is illustrated more or less diagrammatically a preferred form of apparatus for carrying out the invention.

In the drawings:

Fig. 1 is a more or less diagrammatic view in elevation, with parts in section, of a ball mill pulverizer and associated equipment embodying the invention;

Fig. 2 is a detail view in elevation of part of the structure shown in Fig. 1;

Fig. 3 is a transverse cross-sectional view taken on the line 3—3 of Fig. 1; and

Fig. 4 shows another embodiment of the invention.

Referring to Figs. 1, 2 and 3, reference character 10 indicates the shell of a ball mill for pulverizing coal. The shell is rotatably mounted at its ends in trunnions 11 and 12 and is rotated or driven by means of an electric motor 13 which drives a shaft 14 having a spur gear 15 fixed thereon and which meshes with and drives a large spur gear 16 fixed to the shell 10. The interior of the shell 10 is lined with a plurality of liners 17 of steel or other suitable wear resisting material. The mill contains a charge consisting of a mixture of grinding balls 18 of varying diameter and coal 19. The coal to be pulverized is fed or charged automatically to the mill through an inlet conduit 20 which is suitably supported by a support 21. Preheated air is introduced into the mill through an air inlet 22 and the pulverized coal is discharged from the mill through a discharge conduit 23. A fan 34 is connected to conduit 23 and places the mill under suction, that is, below atmospheric pressure. The end 24 of the discharge conduit 23 is cylindrical in form with its inner end 25 flared outwardly and extends somewhat into the mill as shown. The preheated air enters the mill around the outside of this end 24 of the discharge conduit. The air inlet and discharge conduit are supported in position by a suitable support 26. Air may be admitted at the coal charging end 11 or both at the coal charging and coal discharging ends.

The coal (or other product) to be fed to the mill for pulverization is conveyed from a coal bunker, not shown, into a feed hopper 27 from which it descends by gravity onto a rotating feed table 28 which is fixed on a vertically disposed shaft 29. The shaft 29 is rotated by an electric motor 31 through a suitable chain or pulley drive 32. The coal is fed by the rotation of feed table 28 into the conduit 42 through which it falls by gravity into the coal inlet 20.

A relatively small tube 44 of metal or other suitable material is placed in the discharge conduit 23 of the mill. The inner end portion of the tube 44 extends through the inlet end 24 of the discharge conduit as shown, and the extreme inner open end of the tube is disposed in the shell 10 at a point such that its open end is covered by the charge when the mill contains a maximum desired quantity of charge, indicated by the surface lines H—H at the respective center line and transverse sections of Figs. 1 and 3. The outer end portion of the tube 44 extends through an opening 45 in the discharge conduit 23 and through a cover 46 which has an opening therein just large enough to snugly fit the tube. The

outlet end of the tube 44 is connected to a fitting 48 having a plug 49 threaded therein which has a small aperture 50 through which air may be drawn from the atmosphere into the tube. The size of this opening may be varied either by selecting plugs with different sized openings or by any suitable adjustable means so that under the influence of the suction within the mill, the rate of flow of air through the aperture 50 and through the tube 44 may be set at any desired value when the inner end of the tube is open.

Another tube 51 is positioned at the side of the tube 44 in the discharge conduit 23 and the extreme inner end 52 of this tube is disposed in the shell 10 in such position that when there is a minimum desired quantity of charge in the mill, as indicated by the surface lines L—L at the respective sections, the inner open end of this tube is uncovered. An intermediate quantity of charge, as indicated by the surface lines N—N, may be considered as a normal quantity. With a quantity of charge represented by the surface lines N—N, the open end of tube 44 is free, whereas the open end of tube 51 is covered by the charge. The outer end portion of the tube 51 passes through the cover 46 as previously described in connection with the tube 44 and the outer end of tube 51 is connected to a fitting 53 having a plug 54 therein which is provided with an aperture or air opening 55, this fitting, plug and air opening being similar in all respects to the fitting, plug and air opening 48, 49, and 50, respectively. A pet-cock 56 is threaded into the fitting 48 and a length of flexible tubing 57 of rubber or other suitable material is connected at one end to the pet-cock 56 and at its other end to a glass U tube 58. A pet-cock 59 is threaded into the fitting 53 connected to tube 51 and a suitable length of flexible tubing 60 is connected at one end to the pet-cock 59 and at the other end to a glass U tube 61. The U tubes 58 and 61 are each open to the atmosphere at their free ends and are partially filled with water or other suitable liquid to provide an indicator.

A pipe 62 has one end connected to the fitting 48 attached to the tube 44 and has its other end 63 disposed within a counterbalanced bell float 64 which has its open bottom submerged in water or other suitable liquid 65 contained in a container 66. Tube 67 has one of its ends connected to the fitting 53 which is connected to the pipe 51 and has its other end 68 disposed within a counterbalanced bell float 69 which has its open bottom submerged in water or other suitable liquid 70 contained in container 71. As shown, the bell float 64 has a rod 72 extending from the upper portion and has an adjustable screw 73 threaded into a laterally extending arm 74 thereof. The bell float 69 has an operating arm 75 extending from the upper portion thereof and has a screw 76 which is adjustably threaded into a laterally extending arm 77 thereof. The laterally extending portions 74 and 77 of the operating arms 72 and 75 are preferably disposed so that the adjustable screws 73 and 76 will be in substantial alignment and spaced apart. A mercoide switch 78 (or other suitable switch) which is pivoted at 79 is disposed so that its operating arm 80 is positioned between and in alignment with the adjustable screws 73 and 76. Switch points 81 and 82 of the mercoide switch are adapted to be electrically connected by a movable mass of mercury 83 in the switch 78 in the well known manner. Switch point 81 is connected by a wire 84 to one terminal of the electric motor 31 which

operates the coal feed mechanism and switch point 82 is connected by a wire 85 to a source of electric current, such as a generator 86. A wire 87 connects the generator 86 with the other terminal of motor 31.

The operation is as follows:

Assume that the quantity of charge in the mill is that represented by the lines N—N. Under this condition, the inner end of tube 44 is open and due to the suction or low pressure in the mill resulting from the suction of the fan 34, air is drawn into the tube 44 from the atmosphere through the opening 50 in plug 49 in fitting 48. This causes a reduction in pressure below atmosphere in the fitting 48 and if the pet-cock 56 is open, there is a difference in levels of the liquid in the two legs of the U tube 58. This difference is indicated "Δ" on the drawings, the level of the liquid in the open leg of the tube being, of course, the lower. With the quantity of charge in the mill as represented by the lines N—N previously indicated, the inner end 52 of tube 51 is closed by the coal and there is no flow of air or only a very slight flow through the tube 51 from the atmosphere through the opening 55 in plug 54 which is threaded into fitting 53. There is consequently no drop in pressure below atmosphere, or only a very slight drop, in the fitting 53, and with the pet-cock 59 open the levels of the liquid in the two legs of the U tube 61 are at the same level or there is a very slight difference in level only, as is indicated "Δ'". Due to the reduced pressure in the fitting 48 which is communicated to the bell float 64 by means of tube 62, the bell float 64 is in lowered position in the liquid 65 as shown, and because there is substantially no reduction in pressure in the fitting 53, the bell float 69 is in its normal or elevated position in the liquid 70. Assume that under this condition, the switch is closed and coal is being supplied to the mill at a faster rate than the withdrawal of pulverized coal. It will be understood that the coal supply apparatus must supply the coal at a rate at least corresponding to maximum mill capacity, wherefore the supply will usually, if not invariably, be in excess of load requirements when using a constant speed drive for the supply apparatus. This being the case, the charge quantity will increase when the switch is closed.

When the charge in the mill rises until it reaches the maximum desired indicated by the surface lines H—H, the inner end of tube 44 will be closed and substantially no air will be drawn through the tube from the atmosphere. Under this condition, there is no reduction or substantially no reduction in pressure in the fitting 48, and bell 64 rises to its elevated position during which movement the screw 73 contacts the operating arm 80 of mercoide switch 78 and trips the latter, or moves it about its pivot 79, and thus breaks the electrical connection between switch points 81 and 82. This results in stopping the feed motor 31 and stops the feeding of coal into the mill. Inasmuch as the mill continues to rotate by virtue of the driving motor 13 and the withdrawal by means of the fan continues and no coal is being fed to the mill, the charge quantity therein gradually decreases to the minimum or lowest desired value indicated by the lines L—L. When this condition is reached, the inner end 52 of tube 51 will be open or so relieved of blocking by the charge that air is drawn through the tube 51 from the atmosphere, the pressure in fitting 53 is reduced below atmospheric and bell float 69 is caused to

sink. This movement causes the screw 76 to contact the operating arm 80 of the mercoid switch 78 and move it about its pivot 79 to its circuit closed position and cause the switch points 81 and 82 to again be electrically connected. This closing of the motor circuit will start the feed motor 31 which will operate the feed table 28 and cause coal to again be fed into the mill. The result will be that the charge in the mill will rise and, in the continued operation, will fluctuate between the maximum and minimum quantities.

As shown, the U tube 58 functions as the maximum quantity indicator for the mill and the U tube 61 functions as the minimum quantity indicator of the mill. That is to say, when the charge is below the maximum, the inner end of tube 44 is open and there is a material difference in the levels of the liquid in the two legs of the U tube 58. In practice, this difference in levels is in the neighborhood of one-half inch. When the charge is above the minimum in the mill, the inner end 52 of tube 51 is closed and there is a very slight difference in level, if any, in the liquid in the two legs of the U tube 61. It thus follows that the indicators 58 and 61 provide positive and accurate means for indicating the quantity of the charge in the mill and as long as there is a material difference in level in the high indicator 58 and a very slight difference in level in the low level indicator 61, the quantity of the charge in the mill is intermediate the maximum and minimum desired values. It will be understood that the charge level indicating means herein disclosed may be used independently of the charge level controlling means disclosed, and vice versa. It will further be understood that switch throw mechanisms and indicating devices other than those disclosed may be utilized if desired.

While the control of the feed to the mill and consequently the quantity of the charge in the mill has been shown and described as resulting from the starting and stopping of the feed motor, it will be obvious that other equivalent means may be utilized, if desired. For example, the pressure responsive means, such as the bell floats 64 and 69, may be utilized to operate a pilot motor which will function to actuate a speed control device for incrementally regulating the speed of the feed motor, or the pressure responsive device could be utilized to control the pressure of air or other fluid in a closed chamber which would operate a rheostat to control the speed of the feed motor or if a constant speed motor is used for the feed mechanism, the pressure responsive device may be utilized to control the stroke of a pawl and ratchet or other similar mechanism to vary the speed of the feed mechanism. Many other devices and methods will readily suggest themselves to those skilled in the art to which this invention relates. It will be clear that the openings in the manometer or regulator tubes within the mill may be side openings in a tube or other hollow member.

In the embodiment shown in Fig. 4, only one tube is employed. This tube, numbered 90, has an end opening 91 within the pulverizer 10 situated substantially at the operating surface of minimum charge. Tube 90 is connected to a chamber 92 within a relay housing 93. Chamber 92 communicates with the atmosphere through an adjustable opening in valve 94. One side of chamber 92 is formed by a movable member 95 comprising a diaphragm 96 which may be made of impervious flexible material, such as leather, chamois skin or the like. Member 95 is secured

tightly to the relay housing 93 so that a suction may be produced in chamber 92. The side of member 95 opposite chamber 92 is in communication with the atmosphere, as through vents 97. Secured to member 95 is a switch rod 98. A flange 99 is secured on switch rod 98. A flange 100 may be secured to housing 93 or may loosely abut the same. A spring 101 exerts pressure between flanges 99 and 100 thus tending to move rod 98 upwardly and pushing downwardly against the fixed housing 93. Rod 98 operates snap-switch mechanism including a mercoid bulb 78. The switch is pivoted at 79. The switch is connected to wires 84 and 87 of the circuit of motor 31 controlling the supply of material to the mill. The regulator can be adjusted by varying the tension of spring 101 by means of a nut 102 and by means of a turnbuckle 103 for lengthening and shortening the rod 98. A differential pressure gage 104 may be provided and connected by tubes 105 and 106 to the air suction pipe 23 and the regulator impulse tube 90. In this embodiment air is shown as admitted at the inlet trunnion 11, though it will be understood the air may be admitted at various points.

This arrangement operates as follows:

Suction being produced within drum 10, suction will be produced within tube 90 and chamber 92 depending upon the extent of submergence of the end of tube 90 by the coal. The greater the height of coal above the opening 91, the higher will be the pressure in chamber 92. It will be understood that valve 94 is restricted to a greater extent than conduit 90.

Assume now that the position of the parts is as shown on the drawings. The switch is open and no coal is being fed to the pulverizer 10. The fan connected to conduit 23 is removing the coal as it is pulverized. The quantity of charge therefore decreases. As the quantity of charge decreases in the drum, conduit 90 is gradually uncovered and the suction in chamber 92 becomes greater; that is, the pressure becomes lower relative to atmospheric pressure. As the suction increases and consequently the pressure differential on member 95 increases, member 95 moves downwardly against the force of spring 101. When member 95 has moved to the position shown in dash-and-dot lines or substantially thereto, the snap-switch has been pulled beyond dead center and the switch is snapped to closed position. Thereupon the motor 31 is started and coal is supplied to the mill. As the supply continues, being at a greater rate than the rate of withdrawal, the quantity of charge increases. This produces an increasing quantity of material through which the air must pass which is drawn through tube 90 and consequently the fan becomes less effective in reducing the pressure in tube 90. Thus the pressure increases in chamber 92 since the suction in conduit 90 is less effective than the leakage through valve 94 and member 95 rises. When member 95 has risen to or near the position shown in full, the switch is snapped to open position as shown.

The gage 104 registers the differential of pressure in conduits 23 and 90 and therefore indicates the quantity of charge in the mill. A suitable indication may also be obtained by using a single impulse gage connected to conduit 90 or chamber 92.

It will thus be seen that the charge level or the quantity of the charge in the mill is controlled and indicated in response to the pressure or pressures existing in one or more fluid conduct-

ing members, each of which has an opening so disposed in the pulverizer that it will be covered and uncovered by the material being pulverized as the level or quantity thereof varies, thereby regulating the pressure in the hollow members. The material in effect acts as a valve which opens and closes the openings in the fluid conducting members to thereby regulate the fluid flow through these members.

Since many variations may be made in the form of the invention herein disclosed and illustrated, it is intended that the invention is not to be limited except by the scope of the claims appended hereto.

What I claim is:

1. A pulverizer comprising a shell, means for supplying material to be pulverized thereinto, a pressure responsive member adapted to be moved by variations of pressure, a tube connecting the pressure responsive member with the shell, the shell end of said tube being disposed so as to be alternately covered and uncovered by the material in the shell to thereby vary the pressure on the pressure responsive member in accordance with the quantity of material in said shell, and means actuated by said pressure responsive member for controlling the rate of supply of material to the shell.
2. A pulverizer comprising a shell, pulverizing means in the shell, means for feeding material to be pulverized into the shell, suction means connected to said shell, a tube communicating with the atmosphere and having an opening in the shell at a given point with respect to the quantity of charge in the shell, a second tube communicating with the atmosphere and having an opening in the shell at a different given point with respect to the quantity of charge therein, said tubes being adapted to conduct air from the atmosphere into the shell when the openings thereof which are disposed in the shell are not obstructed by the charge, indicating means connected to said tubes to indicate the quantity of charge in the shell, pressure responsive means connected to said tubes and means actuated by the pressure responsive means for controlling the means for feeding material into the shell to thereby control the quantity of the charge therein.
3. The method of operating a pulverizing mill which comprises supplying material thereto, producing suction within the mill, drawing a relatively large volume of air and a separate relatively small additional quantity of air into the mill due to the suction, varying the volume of the relatively small quantity of air introduced by obstructive action of the material in the mill and controlling the rate of supply of material to the mill by the variations in the volume of the relatively small quantity of air introduced into the mill due to the said obstructive action of the material in the mill.
4. The method of operating a pulverizing mill which comprises supplying material thereto, producing a suction within the mill, drawing a relatively large volume of air and relatively small additional quantities of air into the mill at different points due to the suction, varying the relatively small additional quantities of air introduced at the different points by obstructive action of the material in the mill and controlling the rate of supply of material to the mill by the variations in the relatively small additional quantities of air introduced into the mill due to the said obstructive action of the material in the mill.
5. The method of operating a ball pulverizing mill which comprises supplying material thereto, producing a suction within the mill, drawing air into the mill at different points disposed intermediate the desired maximum and minimum levels of the material due to the suction, varying the introduction of air at the different points by obstructive action of the material in the mill as the level of the material varies and indicating said variations of air introduction.
6. A pulverizer comprising a rotatable shell, pulverizing means in the shell, means for feeding into the shell material to be pulverized, suction means connected to the shell, and pressure responsive means including a tube having an opening in the shell disposed intermediate the levels of the desired maximum and minimum charges of material in the shell whereby said opening is alternately covered and uncovered by the variations in the level of the charge in the shell and means actuated by the pressure responsive means for controlling the material feeding means.
7. A pulverizer comprising a rotatable shell, pulverizing means in the shell, means for feeding into the shell material to be pulverized, suction means connected to the shell, and pressure responsive means including a tube having an opening in the shell disposed intermediate the levels of the desired maximum and minimum charges of material in the shell whereby said opening is alternately covered and uncovered by the variations in the level of the charge in the shell, means actuated by the pressure responsive means for controlling the material feeding means and means associated with the pressure responsive means for indicating the level of the charge in the shell.
8. A pulverizer comprising a shell, pulverizing means in the shell, means for feeding into the shell material to be pulverized, suction means connected to the shell, and pressure responsive means including a tube communicating with the atmosphere and having an opening in the shell disposed intermediate the levels of the maximum and minimum charges of material in the shell and through which air is adapted to be drawn from the atmosphere into the shell whereby said opening is alternately covered and uncovered by the variations in the level of the charge in the shell and means actuated by the pressure responsive means for controlling the material feeding means.
9. A pulverizer comprising a shell, pulverizing means in the shell, means for feeding into the shell material to be pulverized, suction means connected to the shell, and pressure responsive means including a relatively small tube having an opening in the shell disposed intermediate the levels of the desired maximum and minimum charges of material in the shell whereby said opening is alternately covered and uncovered by the variations in the level of the charge in the shell and means actuated by the pressure responsive means for controlling the material feeding means.
10. A pulverizer comprising a shell, pulverizing means in the shell, means for feeding into the shell material to be pulverized, suction means connected to the shell, and pressure responsive means including a tube having an opening in the shell disposed intermediate the desired maximum and minimum charges of material in the shell whereby said opening is alternately covered and uncovered by the variations in the level of the charge in the shell, means actuated by the pressure responsive means for controlling the material feeding means and an indicator connected

with said tube and with the suction means for indicating the quantity of material in the shell.

11. A pulverizer comprising a shell, pulverizing means in the shell, means for feeding material to be pulverized into the shell, suction means connected to said shell, a tube communicating with the atmosphere and having an opening in the shell disposed at a point somewhat below the desired maximum level of the material to be pulverized in the shell, a second tube communicating with the atmosphere and having an opening in the shell disposed somewhat above the desired minimum level of the material to be pulverized in the shell, said tubes being adapted to conduct air from the atmosphere into the shell when the openings which are disposed in the shell are not obstructed by the charge, pressure responsive means connected to said tubes and means actuated by the pressure responsive means for controlling the means for feeding material into the shell to thereby control the quantity of the charge therein.

12. A pulverizer comprising a shell, pulverizing means in the shell, means for feeding material to be pulverized into the shell, suction means connected to said shell, a tube communicating with the atmosphere and having an opening in the shell disposed at a point somewhat below the desired maximum level of the material to be pulverized in the shell, a second tube communicating with the atmosphere and having an opening in the shell disposed somewhat above the desired minimum level of the material to be pulverized in the shell, said tubes being adapted to conduct air from the atmosphere into the shell when the openings which are disposed in the shell are not obstructed by the charge, a bell float connected with each of said tubes and means actuated by the bell floats for controlling the means for feeding material into the shell to thereby control the quantity of the charge therein.

13. A pulverizer comprising a shell, pulverizing means in the shell, means for feeding into the shell material to be pulverized, suction means connected to the shell, and pressure responsive means including a diaphragm and a tube having one end disposed adjacent one side of said diaphragm and having its other end disposed in the shell intermediate the levels of the desired maximum and minimum charges of material in the shell whereby said end of the tube in the shell is alternately covered and uncovered by the variations in the level of the charge in the shell and means actuated by said diaphragm for controlling the material feeding means.

14. A pulverizer comprising a rotatable shell, pulverizing means in the shell, means for feeding material to be pulverized into the shell, suction means connected to said shell, a hollow member having a relatively small opening disposed in the shell intermediate the desired maximum and minimum levels of the material and adapted to be obstructed by material in the shell, pressure responsive means connected to said hollow member, and means actuated by said pressure responsive means for controlling said feeding means.

15. A pulverizer comprising a shell, means for supplying material to be pulverized therein, a pressure responsive member adapted to be moved by variations of pressure, means to vary the pressure on the pressure responsive member in accordance with the quantity of material in said shell including a hollow member having a relatively small opening disposed in said shell intermediate the desired maximum and minimum

levels of the material and adapted to be covered and uncovered by the material in the shell, and means actuated by said pressure responsive member for controlling the rate of supply of material to the shell.

16. In combination with a ball mill pulverizer, means for feeding material to be pulverized to the mill, means for withdrawing air from the mill to produce a suction therein, a tube having one end disposed in the mill intermediate the desired maximum and minimum levels of the material, said end of the tube being adapted to be covered and uncovered by variations in the level of the material in the mill, and a pressure responsive device connected with the tube for indicating the quantity of material in the mill.

17. A pulverizer comprising a shell, pulverizing means in the shell, means for feeding material to be pulverized into the shell, suction means connected to said shell, a hollow member having a relatively small opening disposed in the shell intermediate the desired maximum and minimum levels of the material and adapted to be obstructed by material in the shell, pressure responsive means connected to said hollow member and means actuated by said pressure responsive means for controlling said feeding means.

18. In combination with a pulverizer, means for feeding material to be pulverized therein, means for producing a difference in pressure between the atmosphere and the interior of the pulverizer, fluid conducting means having an opening in the pulverizer and disposed so that the opening will be covered and uncovered by the material as the quantity thereof varies, and means connected with the fluid conducting means for indicating the quantity of material in the pulverizer.

19. In combination with a pulverizer, means for feeding material to be pulverized therein, means for producing a difference in pressure between the atmosphere and the interior of the pulverizer, a tube having an opening in the pulverizer and disposed so that the opening will be covered and uncovered by the material as the quantity thereof varies, and means connected with the tube for indicating the quantity of material in the pulverizer.

20. In combination with a pulverizer, means for feeding material to be pulverized therein, means for producing a difference in pressure between the atmosphere and the interior of the pulverizer, a plurality of fluid conducting means each having an opening in the pulverizer and disposed so that the opening will be covered and uncovered by the material as the quantity thereof varies, each of said openings being disposed at different points in the pulverizer, and means connected with the fluid conducting means for indicating the quantity of material in the pulverizer.

21. In combination with a pulverizer, means for feeding material to be pulverized therein, means for producing a difference in pressure between the atmosphere and the interior of the pulverizer, fluid conducting means having an opening in the pulverizer and disposed so that the opening will be covered and uncovered by the material as the quantity thereof varies, and means connected with the fluid conducting means for controlling said feeding means.

22. In combination with a pulverizer, means for feeding material to be pulverized therein, means for producing a difference in pressure between the atmosphere and the interior of the pulverizer, a plurality of fluid conducting means

each having an opening in the pulverizer and disposed so that the opening will be covered and uncovered by the material as the quantity thereof varies, each of said openings being disposed at different points in the pulverizer, and means connected with the fluid conducting means for controlling said feeding means.

23. In combination with a pulverizer, means for feeding material to be pulverized thereinto, means causing air to flow into the pulverizer and to flow therefrom carrying pulverized material in suspension, and fluid pressure responsive means for indicating the quantity of the material being pulverized, said means having a tubular part so disposed in the pulverizer that the material being pulverized comes into contact therewith and thereby causes the indicating means to be actuated.

24. In combination with a pulverizer, means for feeding material to be pulverized thereinto, means causing air to flow into the pulverizer and to flow therefrom carrying pulverized material in suspension, and fluid pressure responsive means for controlling the feeding means, said means having a tubular part so disposed in the pulverizer that the material being pulverized comes into contact therewith and thereby causes the controlling means to be actuated.

25. A pulverizer comprising a rotatable shell, pulverizing means in the shell, means for feeding material to be pulverized thereinto, the shell having an air inlet and an outlet above the maximum desired level of the material therein, means causing air to flow into the shell through the inlet and over the surface of the material therein and through the outlet carrying pulverized material in suspension and fluid pressure responsive means controlled by the level of the material in the shell for indicating the quantity of material being pulverized therein.

26. A pulverizer comprising a rotatable shell, pulverizing means in the shell, means for feeding material to be pulverized thereinto, the shell having an air inlet and an outlet above the maximum desired level of the material therein, means causing air to flow into the shell through the inlet and over the surface of the material therein and through the outlet carrying pulverized material in suspension, and fluid pressure responsive means controlled by the level of the material in the shell for controlling the feeding means to thereby control the quantity of the material being pulverized therein.

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