Aug. 6, 1929. W. T. DOYLE 1,723,726

APPARATUS FOR PULVERIZING MATERIALS

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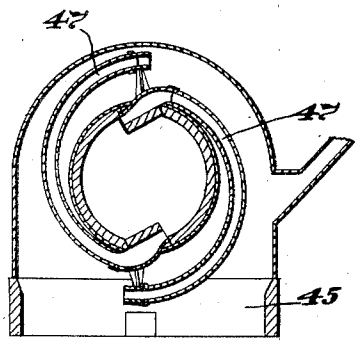


Fig. 2

Fig. 1

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Fig. 3

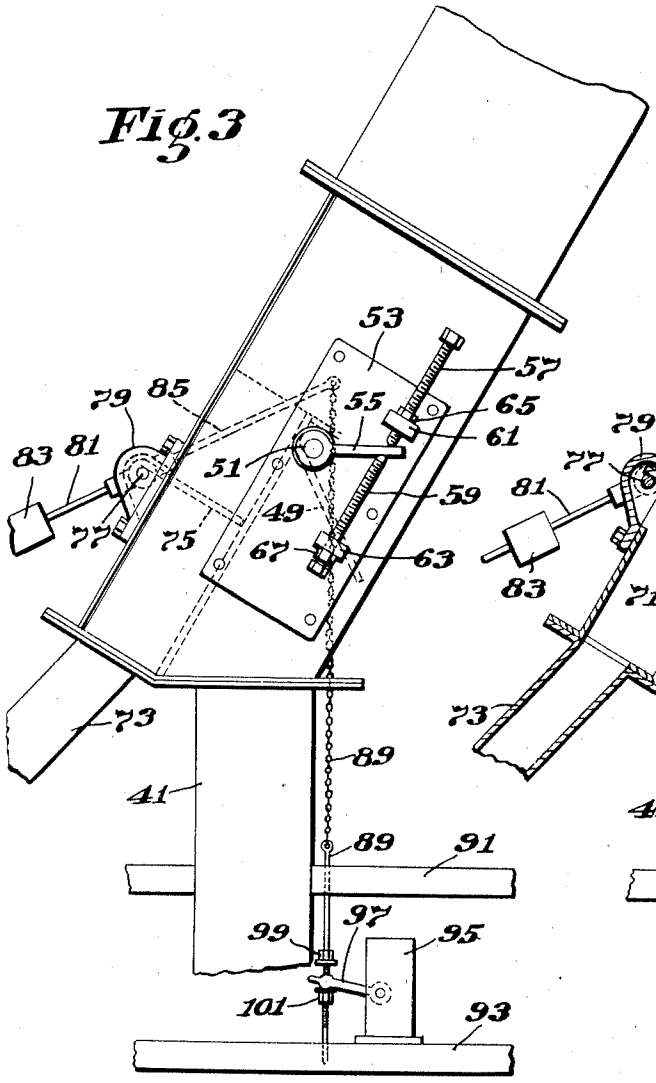
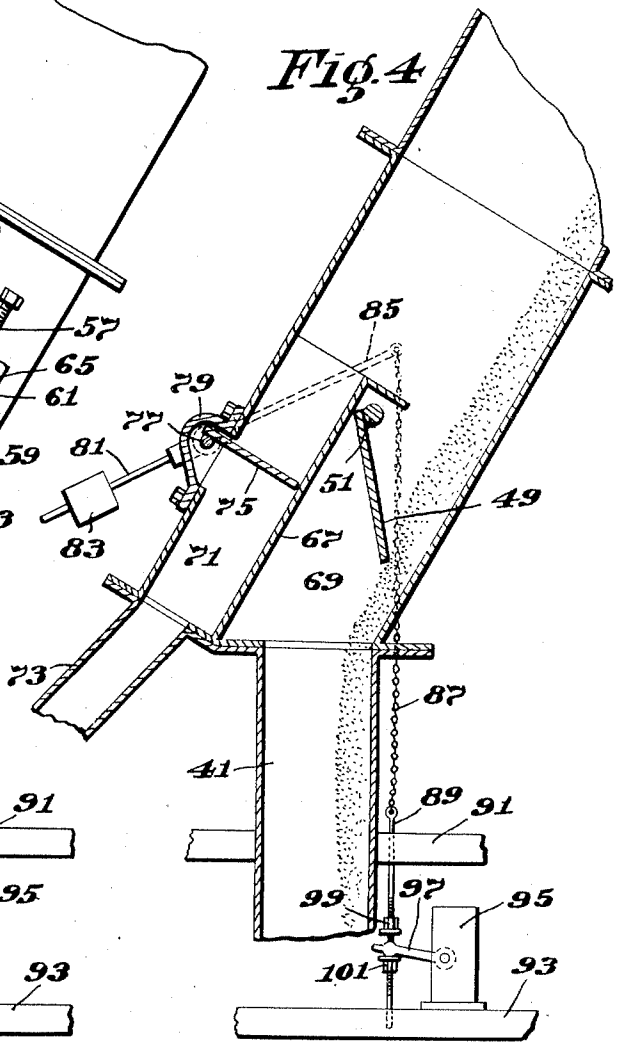


Fig. 4



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR PULVERIZING MATERIALS.

Application filed November 19, 1928. Serial No. 320,306.

The invention to be hereinafter described relates to apparatus for reducing materials.

Many natural and manufactured materials vary in their degree of hardness, and of course, the harder the material, the more difficult it is to grind. A grinding machine for maximum efficiency should have a uniform rate of feed of material to the machine, uniform fineness of the ground product, and maximum output. However, owing to the varying degree of hardness of the material, it is usually necessary to vary the rate of feed of material to the machine. Grinding machines are equipped with various types of feeders, but usually they are not capable of nicety of regulation, and consequently variations in the feed are objectionably large. In machines requiring a short time for reducing material, increase in the rate of reducing the material is rapid and can be promptly observed, but in machines requiring a long time for reducing material, such as are employed for high tonnages, increase in the rate of reducing the material is on such a large scale that it has been found difficult to regulate.

The purpose of the present invention, therefore, is to provide means to regulate the feed of unground material to the mill automatically in response to the frangibility of the material being ground. The regulation is such that on increase in hardness of material above normal, the speed of the feeding means will be reduced, or the feeding means will be arrested, and on decrease in hardness of material, the feeding means will be started or its speed will be increased, to the end that the material may be reduced by the mill with uniform fineness of product and with maximum output.

In carrying the invention into practical effect, in the present instance there is provided a ball tube mill having plural compartments in which stages of reduction of the material occur. The material to be reduced is fed into one end of the mill, and the ground material is delivered from the opposite end of the mill and conveyed to a separator which may be an air or a screen separator. The tailings delivered by the separator are returned to the mill for further reduction.

It is important that the compartments of the mill shall not be overloaded with material, since excess material in a compartment will prevent the balls from having their desired grinding effect. Another purpose of the invention, therefore, is to provide means to prevent overloading of the compartments, so that the balls therein may always operate efficiently. To accomplish this, a limited stream of tailings is delivered to one compartment of the mill, and any tailings in excess of said limited stream are delivered to another compartment of the mill, and variations in the excess stream may be utilized automatically to regulate the means for feeding the material to the mill.

The character of the invention may be best understood by reference to the following description of one good form thereof shown in the accompanying drawings, wherein:

Fig. 1 is an elevation of the apparatus;

Fig. 2 is a vertical section taken on the line 2—2 of Fig. 1;

Fig. 3 on an enlarged scale is a side elevation of portions of the chute and showing the regulation devices thereof; and

Fig. 4 is a vertical section through the chutes.

Referring to the drawings, the apparatus shown therein as one good form of the invention, comprises a ball tube mill 1 (Fig. 1) comprising a rotary tube having heads 3 and 5 at opposite ends thereof. The head 3 has a hollow trunnion journalled in a bearing 7 mounted on a pier 9 on the foundation 11. The head 5 has a hollow trunnion journalled in a bearing 13 mounted on a pier 15 on the foundation.

The tube contains a primary reducing compartment in the end portion 17, and a secondary reducing compartment in the end portion 19 thereof. These compartments have linings and contain suitable reducing media which may be in the form of balls or other elements. The balls in the primary reducing compartment are larger than those in the secondary reducing compartment. Between these compartments in a division plate for automatically transferring material reduced in the primary compartment to the secondary compartment. Since the

internal construction of this ball tube mill is usual and understood in the art, it is unnecessary to show and describe the same in detail herein.

Mounted on a frame 21 at one end of the tube is a feeder 23 of well known type driven by an electric motor 25. The material is conducted from the feeder by a chute 27 to the hollow trunnion of the tube head 3, and passes therethrough into the primary reducing compartment. It passes thence through the division plate into the secondary reducing compartment. The material is delivered from the latter through the hollow trunnion of the tube head 5 to a hopper 29 provided with a screw conveyer 31 for conducting the material to the base of an elevator 33.

The material is conveyed by this elevator to an air separator 35, such, for example, as is disclosed in Letters Patent No. 1,615,558, granted in the name of Thomas J. Sturtevant, Janurary 25, 1927. The fines may be conducted away from the separator by a screw conveyer 37 at the lower end thereof, and the tailings which are rejected may be conducted from the separator through a main chute 39.

A limited stream of tailings may be conducted from the main chute through a branch chute 41 which leads to a housing 43 (Fig. 2) extending over the ball tube mill and having a sump 45 at the base thereof. The tube of the mill is provided with a pair of scoops 47 which on rotation of the tube automatically pick up material from the sump and transfer it into the secondary reducing compartment of the tube.

To regulate the volume of the limited stream of tailings delivered to the secondary compartment, the chute is provided with a valve 49 (Fig. 4) fast on a shaft 51 mounted in bearings in plates 53 at opposite sides of the chute. This shaft has an arm 55 extending between a pair of adjusting screws 57 and 59 respectively threaded in lugs 61 and 63 on one of the plates 53, said screws being provided with lock nuts 65 and 67. The construction is such that on adjustment of the screws the valve 49 may be angularly adjusted and held in the positions desired, thereby to vary the space between the valve and a wall of the chute, and regulate the volume of the limited stream of tailings delivered to the secondary compartment of the mill.

The main chute has a partition 67 therein dividing the chute into passages 69 and 71. The passage 69 may be regarded as a part of the branch chute 41.

Extending from the passage 71 is a branch chute 73 which leads to the feed chute 27 referred to for conducting material to the mill.

Any tailings in excess of the limited stream flowing through the chute 41 to the secondary compartment, will accumulate and pile upon the valve 49, and when they reach a sufficient height, they will flow over the partition 67 and the excess tailings will flow through the passage 71 which may be regarded as a part of the chute 73 and be conducted by the latter to the feed chute 27, and pass thence to the primary compartment of the mill.

It is desirable that the excess stream of tailings shall be utilized to regulate the speed of feed of the motor. If the excess stream increases, the speed of the motor should be reduced, but on the other hand, if the excess stream decreases, the speed of the motor should be increased. To accomplish this regulation, in the present instance a valve 75 is provided in the passage 71, and is fast on a shaft 77 mounted in bearings in a box 79 mounted on the main chute. Fast on the shaft is an arm 81 carrying the counterbalance weight 83. Also fast on the shaft is an arm 85. A chain 87 has its upper end connected to this arm, and its lower end connected to a rod 89 passing through holes in supports 91 and 93. Mounted on the support 93 is a switch box 95 provided with an arm 97 having a fork receiving the rod 89. Nuts 99 and 101 are threaded on this rod at opposite sides of the fork. The switch in the box 95, in the present instance is constructed to provide two speeds for the motor 25. Since such a switch is understood in the art, it is unnecessary to show and describe the same in detail herein.

In operation, material is fed by the feeder 23 through the chute 27 into the primary reducing compartment of the mill. The material passes thence through the division plate into the secondary reducing compartment of the mill and is delivered therefrom into the hopper 29 and conducted by the elevator 33 to the air separator 35, which divides the materials into fines and tailings. The fines are conducted by the screw conveyer 37 from the separator. The tailings enter the main chute 39. The valve 49 is set to provide the desired limited stream of tailings to pass to the sump 45 and be transferred by the scoops 47 into the secondary compartment. This limited stream is so regulated that excess tailings will not be returned to the secondary compartment and interfere with efficient reduction of materials therein. If tailings in excess of this limited stream enter the main chute, they will build upon the valve 49 and flow over the partition 67, and when they build up on the valve 75, the latter will be rocked in a clockwise direction (Fig. 4), and through the chain 87, rod 89 and nut 99 will rock the switch box arm 97 downward and cause the electric motor to rotate at its lower speed, thereby to reduce the amount of ma-

terial fed into the tube mill. When the excess stream ceases or becomes sufficiently light, the counterbalance weight 83 will close the valve 75 and through the chain 87, rod 89 and nut 101 will rock the switch box arm up and cause the electric motor to rotate at its higher speed, thereby to increase the amount of material fed to the mill.

The switch box arm 97 has a small range of movement, and therefore, will be operated on initial rocking of the valve 75. The provision of the chain 87 is desirable in the connections for imparting movement from the valve to the switch arm, since the chain will permit the valve to move on to wide open position without effecting further movement of the switch arm in case there is sufficient volume of excess material to cause the valve to move to wide open position.

By this invention simple and efficient means is provided for preventing overloading of the compartments of the mill, thereby desirably controlling the efficient operation of the mill and enabling an automatic regulation of the feed which results in uniform fineness in material being ground and maximum output of the mill.

It will be understood that the invention is not limited to the specific embodiment shown, and that various deviations may be made therefrom without departing from the spirit and scope of the appended claims.

What is claimed is:

1. The combination of a plural compartment mill for reducing material, means for feeding material to the mill, a separator for receiving material from the mill, means for dividing the tailings from the separator into streams and delivering the same into different compartments of the mill for further reduction, and means operable in response to one of said streams for controlling the feeding means.

2. The combination of a plural compartment mill for reducing material, means for feeding material to the mill, a separator for receiving material from the mill, means for delivering a limited stream of tailings from the separator to one of the mill compartments, means for delivering a stream of tailings in excess of said limited stream to another compartment in the mill, and means operable in response to variations in the stream of excess tailings for automatically controlling the feeding means.

3. The combination of a plural compartment mill for reducing material, means including an electric motor for feeding material to the mill, a separator for receiving material from the mill, means for delivering a limited stream of tailings from the separator to one of the mill compartments, means for delivering a stream of tailings in excess of said limited stream to another compartment of the mill, and means operable in response to variations in the stream of excess tailings for automatically regulating the speed of the motor.

4. The combination of a plural compartment mill for reducing material, a separator for receiving material from the mill, means for conducting a limited stream of tailings from the separator to one of the compartments of the mill, and means for conducting any tailings in excess of said limited stream to another compartment of the mill, thereby to prevent overloading of the mill.

5. The combination of a plural compartment mill for reducing material, means for feeding material to the mill, a separator for receiving material from the mill, a chute for conducting a limited stream of tailings from the separator to one of the compartments of the mill, a chute for conducting any tailings in excess of said limited stream to another compartment of the mill, a valve in the latter chute, and means operated by said valve for automatically controlling the feeding means.

6. The combination of a plural compartment mill for reducing material, means including an electric motor for feeding material to the mill, a separator for receiving material from the mill, a chute for conducting a limited stream of tailings from the separator to one of the compartments of the mill, a chute for conducting any tailings in excess of said limited stream to another compartment of the mill, a valve in the latter chute, and means operated by said valve for automatically regulating the speed of the motor.

7. The combination of a plural compartment mill for reducing material having a sump, and means for transferring material from the sump to one of the compartments of the mill, means for feeding material to the mill, a separator for receiving material from the mill, means for conducting a limited stream of tailings from the separator to the sump, means for conducting any tailings in excess of said limited stream to another compartment of the mill, and means operated by the excess tailings for automatically controlling the feeding means.

8. The combination of a plural compartment ball tube mill for reducing material, means for feeding material to the mill, a separator for receiving material from the mill, a chute for conducting a limited stream of tailings from the separator to one of the compartments of the mill, a chute for conducting any tailings in excess of said limited stream to another compartment of the mill, valves in said chutes, and means operated by one of said valves for regulating the speed of the feeding means.

9. The combination of a plural compartment mill for reducing material, means for

feeding material to the mill, a separator for receiving material from the mill, a chute for conducting a limited stream of tailings from the separator to one of the compartments, a chute for conducting any tailings in excess of said limited stream to another compartment, a valve in the latter chute, and means operated by said valve for controlling the feeding means and having provision for increasing the speed on closure of said valve and for decreasing the speed on opening of said valve.

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