J. S. FASTING.

FEED REGULATOR FOR GRINDING MILLS.

APPLICATION FILED NOV. 13, 1914.

1,157,979.

Patented Oct. 26, 1915.

2 SHEETS—SHEET 1.

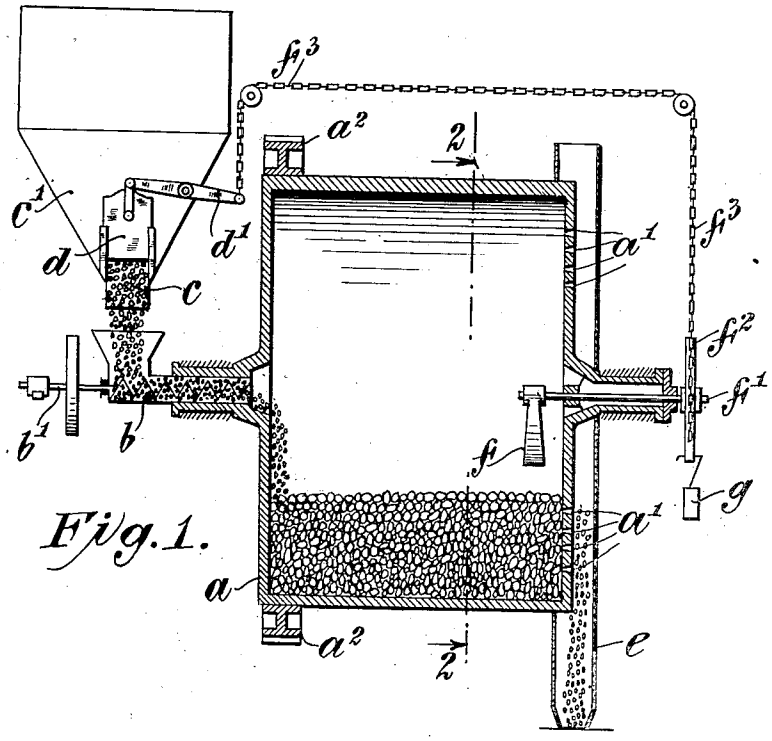


Fig. 1.

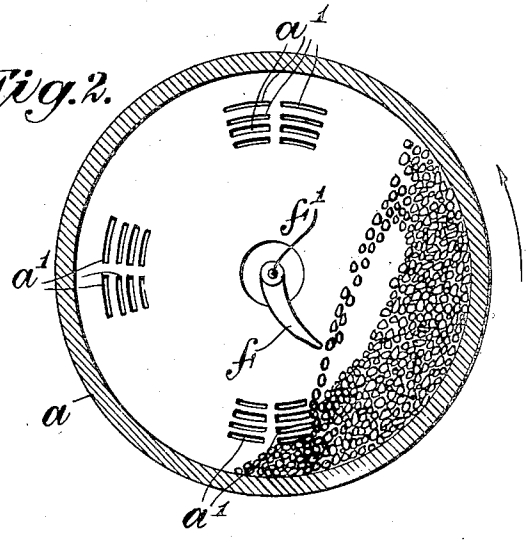


Fig. 2.

WITNESSES

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2 SHEETS—SHEET 2.

Fig. 3.

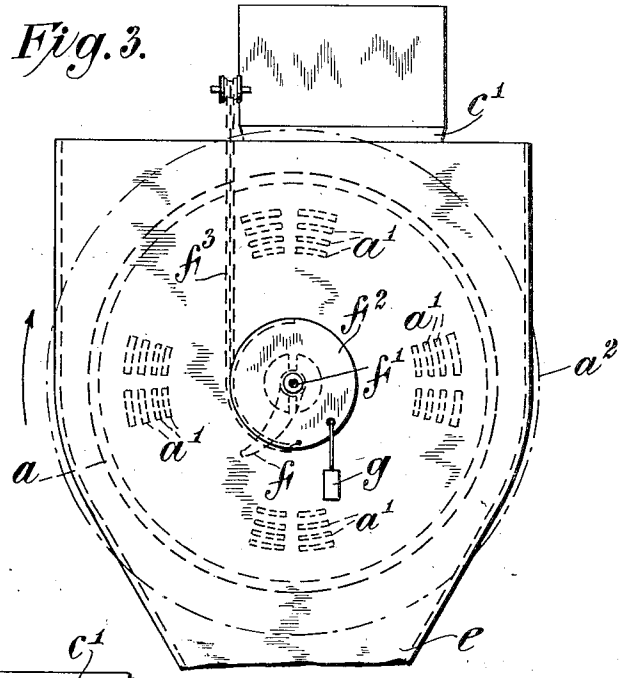
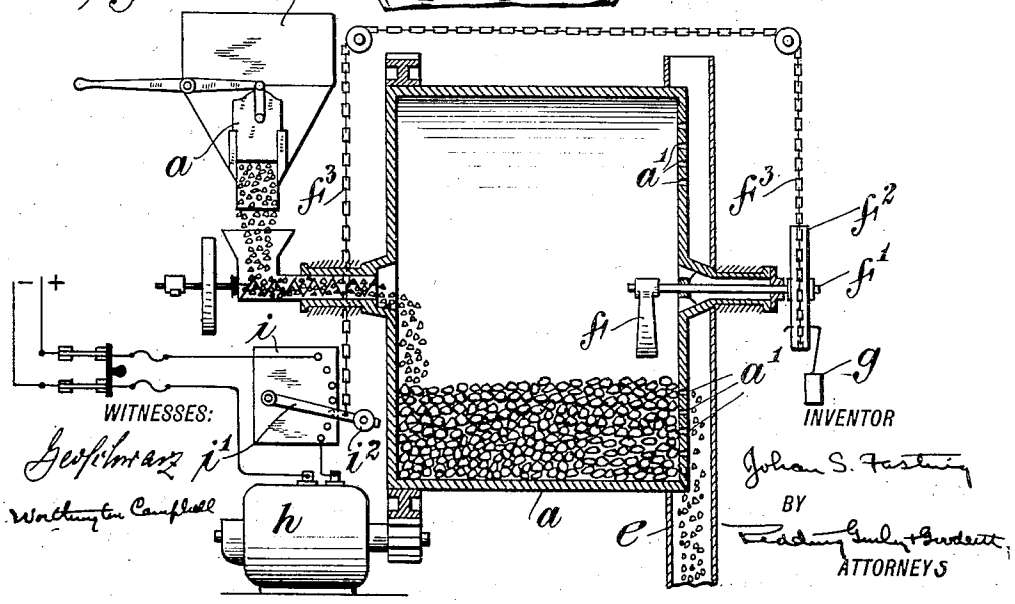


Fig. 4.



UNITED STATES PATENT OFFICE.

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FEED-REGULATOR FOR GRINDING-MILLS.

1,157,979. Specification of Letters Patent. Patented Oct. 26, 1915.

Application filed November 13, 1914. Serial No. 871,851.

To all whom it may concern:

Be it known that I, JOHAN S. FASTING, a subject of the King of Denmark, residing in Frederiksberg, near Copenhagen, Denmark, have invented certain new and useful Improvements in Feed-Regulators for Grinding-Mills, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof.

This invention relates to high speed grinding mills in which the material to be ground is carried up the side of a rotating mill with suitable grinding bodies, such as balls, and permitted to tumble down upon itself in such a manner as to crush or pulverize the particles of the material. One of the primary considerations in the operation of a mill of this character is the speed of grinding of the material, that is to say, it is important that the material shall pass through the mill as rapidly as possible in order that the quantity ground in any unit of time shall be a maximum. Under some conditions of use, it becomes possible to rotate the mill at a speed higher than the critical speed, so that the material is carried around the wall of the mill by centrifugal action and permitted to have a relatively short drop for the pulverizing action. When the machine is rotated at such a speed, however, the tendency is for the material to gather in the mill and eventually prevent any cascading or pulverizing movement.

The present invention has for its principal object to provide devices which will increase the output of a mill of the character referred to and to provide devices in combination with the mill for regulating the speed of rotation thereof or the rate of feed of the material into the mill.

In accordance with the invention, what may be termed a regulator arm, or its equivalent, is positioned within the mill so that normally it will not interfere with or be touched, by the grinding bodies or the material, but which, when the rate of feed or the speed of the mill exceed a predetermined point of efficient operation, will be acted on by the grinding bodies and the material and will bring about a reduction in the rate of feed of the material or a reduction in the speed of rotation of the mill. The control referred to is mentioned merely as an illustration of two feasible ways in which the desired purpose may be accomplished, which is, the increasing of the capacity of a high speed mill, but it will be understood as this description proceeds that the mechanical action on the regulator arm may be converted into useful work for the purpose of controlling other conditions than those above referred to.

The invention will be described more particularly with reference to the accompanying drawings in which—

Figure 1 is a view partly in vertical section and partly in elevation of a complete plant constructed in accordance with the present invention and showing the regulator arm connected to the feed valve of the material whereby the rate of feed may be controlled. Fig. 2 is a sectional view taken on the plane indicated by the line 2—2 of Fig. 1 and looking in the direction of the arrows. Fig. 3 is a view in end elevation of the mill shown in Fig. 1. Fig. 4 is a view, partly in vertical section and partly in elevation, of a complete plant constructed in accordance with the present invention and showing the regulator arm connected to the controlling member of the driving motor for the drum whereby the speed of rotation of the drum may be controlled.

The high speed grinding mill a may be of any approved type, having means for feeding the material thereinto, such means being illustrated herein as a screw conveyer b disposed with its inlet directly beneath a discharge opening c formed in a hopper c', the area of the discharge opening and the rate of feed of the material therethrough being controlled by a suitable valve d. The screw conveyer b may be rotated by power applied to its shaft b' in any approved manner. The material may be discharged from the mill through openings a' formed in the discharge head thereof from whence it passes into a casing e, all as is well understood. During rotation of the mill counterclockwise, as indicated in Fig. 2, the material with the grinding bodies, such as balls, is carried up the side of the wall for a certain distance and then permitted to tumble down or cascade upon itself so as to bring about the desired grinding action. It will be appreciated that where the speed of rotation of the mill becomes too high or the rate of feed of the material exceeds a certain point, the material will become so thick that the cascading effect referred to cannot be effective for the grinding action demanded. In ac-

cordance with this invention this difficulty is overcome by providing within the mill, a device, such as the arm *f*, which will be struck by the material and the grinding bodies when the capacity of the mill is exceeded. On the other hand, during the normal operation of the mill, the material does not touch this regulator arm. In the embodiment illustrated in the accompanying drawings, the regulator arm *f* is mounted on an oscillatory shaft *f'* which extends to a point without the mill and carries adjacent its free end a sheave f^2 or its mechanical equivalent, the sheave being connected operatively by a chain f^3 and lever *d'* to the feed valve *d*. To maintain the parts of the regulating device in stable position during normal operation of the mill, the arm *f*, which is of appreciable weight, may be positioned with its center of gravity outside of its base and this unbalanced weight may be counterbalanced by means of a counterweight *g* secured to the sheave f^2.

In operation, the material is fed into the mill at such a rate and the mill is rotated at such a speed, by an annular gear a^2, that the material and grinding bodies are permitted to cascade either to one side or to the other of the arm *f*, without touching the arm, this condition being maintained until the capacity of the mill is exceeded. If the material accumulates in the mill so that its thickness prevents the continuance of the cascading movement, it will contact with the regulator arm *f* and bear the same downward so as to rock the shaft *f'* and bring about a partial closing of the valve *d*. The rate of feed of the material will thereby be decreased until such time as the material assumes its normal cascading movement and falls free of the regulator arm. The result is that the quantity of material within the mill is regulated at all times automatically for a given speed of rotation and the mill may accordingly be operated at its maximum capacity.

It should now be understood that the construction of the regulating devices may be varied widely, it being necessary only that there be within the mill, some member which is acted on mechanically by the grinding bodies or by the grinding bodies and the material when the capacity of the mill is exceeded and that this member should be connected operatively without the mill with means for controlling either the rate of feed of the material or the speed of rotation of the mill, or both. It will also be understood that other conditions affecting the capacity of the mill may be controlled by other regulating devices functioning to insure continuous operation of the mill at maximum capacity. For instance, the arm *f* might be made to control the rheostat of an actuating prime mover for the rotating mill. Such an embodiment is shown in Fig. 4 where the drum *a* is illustrated as being driven by an electric motor *h* in the circuit of which is disposed any approved form of controlling rheostat *i*, the arm *i'* of which may be weighted, as at i^2, to move the arm in one direction and may have secured thereto the free end of the chain f^3, the latter being connected operatively to the arm *f* in the same manner as described with respect to the embodiment shown in Fig. 1. The rheostat *i* is so formed that whenever the material and grinding bodies, or either of them, bank up in the drum *a* and act on the arm *f*, the rheostat arm *i'* will be moved to increase the speed of rotation of the motor *h* and the drum. As the speed of rotation increases, it will be understood that the material is discharged more rapidly so that for any given rate of inflow of the material past the valve *d* of the hopper *c'*, the speed of rotation will be so controlled automatically as to regulate the rate of discharge of the material and thereby insure the operation of the mill at its maximum capacity, as is contemplated with the structure shown in Fig. 1.

The general scope of the invention having now been pointed out and a detailed description of one form of apparatus for practicing the invention having been given, it remains to define the general scope of the invention by the appended claims.

I claim as my invention:—

1. In a grinding mill, the combination with the grinding bodies, of means disposed within the mill to govern automatically the supply of material to the mill or the speed of rotation thereof, said means being disposed within the mill and mounted out of the path of the material during the normal operation of the mill, but adapted to be struck by the material and grinding bodies and moved when the capacity of the mill is exceeded, such movement serving to effect the said governing action.

2. In a high speed grinding mill, the combination with the grinding bodies, of a valve to control the inflow of the material to be ground, and means disposed within the mill and connected operatively to said valve to govern the position of the valve, said means including an arm arranged out of the path of the material during the normal operation of the mill but adapted to be struck by the material and moved when the capacity of the mill is exceeded, such movement serving to move the valve to decrease the inflow of the material.

3. In a high speed grinding mill, the combination with the grinding bodies, of a valve to control the inflow of the material to be ground, means disposed within the mill and connected operatively to said valve to govern the position of the valve, said means in-

cluding an arm arranged out of the path of the material during the normal operation of the mill but adapted to be struck by the material and moved when the capacity of the mill is exceeded, such movement serving to move the valve to decrease the inflow of the material, and means coöperating with the valve to restore it automatically to its normal position upon resumption of normal operation of the mill.

4. In a high speed grinding mill, a hopper for the material provided with a discharge opening and valve to control the flow of material through the discharge opening into the mill, a shaft passing through the discharge head of the mill and arranged axially of the mill, an arcuate arm carried on the inner end of the shaft and disposed radially of the mill, a sheave mounted on the outer end of the mill, an operative connection between the sheave and the valve, and a counterweight carried on the sheave to maintain the radial arm in normal position, the arm being arranged to be struck by the material and moved to close the valve when the capacity of the mill is exceeded, the counterweight serving to restore the valve to its normal position as soon as the mill again operates at its normal capacity.

This specification signed and witnessed this 17th day of October A. D., 1914.

JOHAN S. FASTING.

Signed in the presence of—
AXEL PERMIER,
CHR. ENGELHART.