

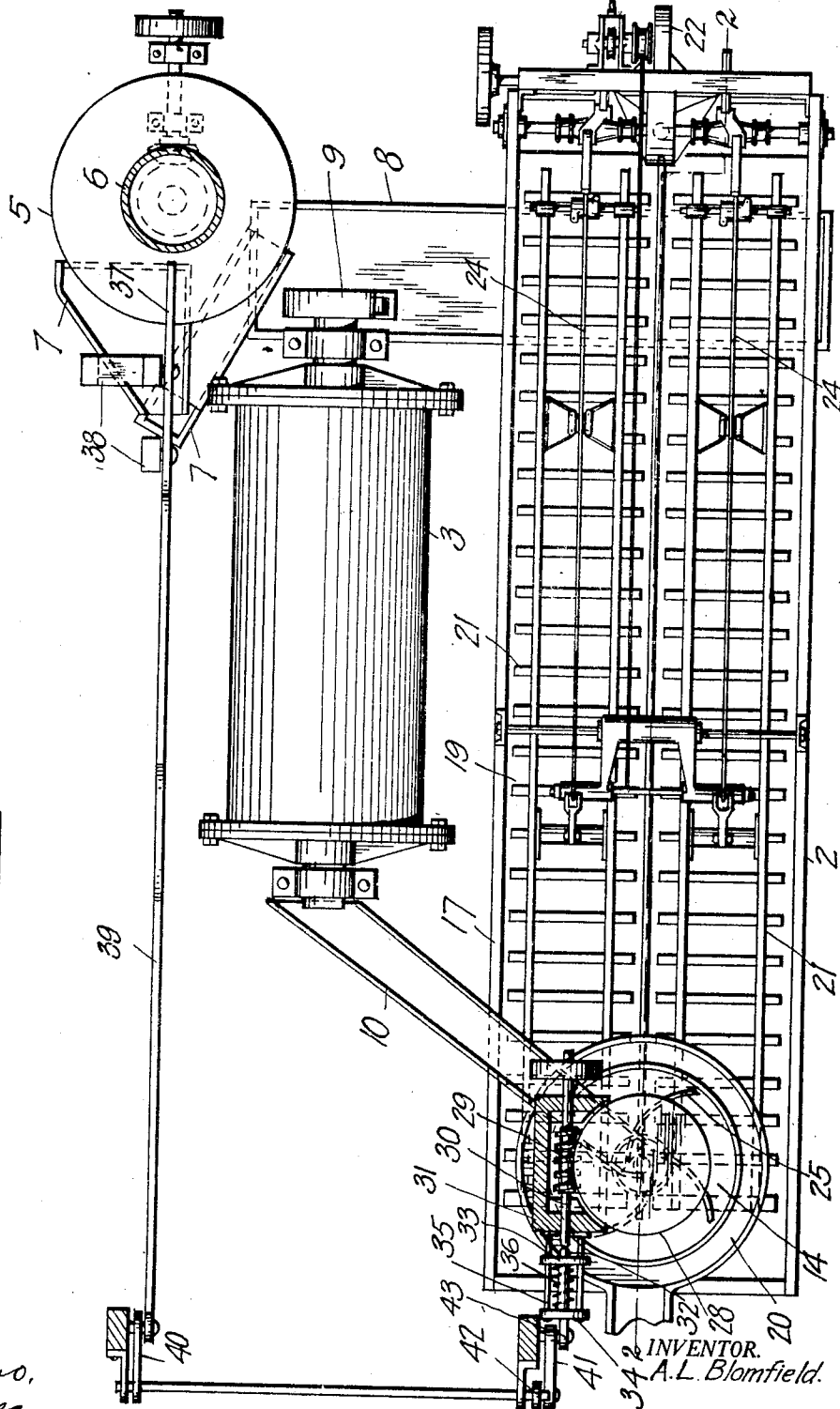
1,294,864.

A. L. BLOMFIELD.
ORE TREATING APPARATUS.
APPLICATION FILED AUG. 27, 1917.

Patented Feb. 18, 1919.

3 SHEETS—SHEET 1.

FIG. 1



WITNESS:
J. H. Curran,
L. Rhoades

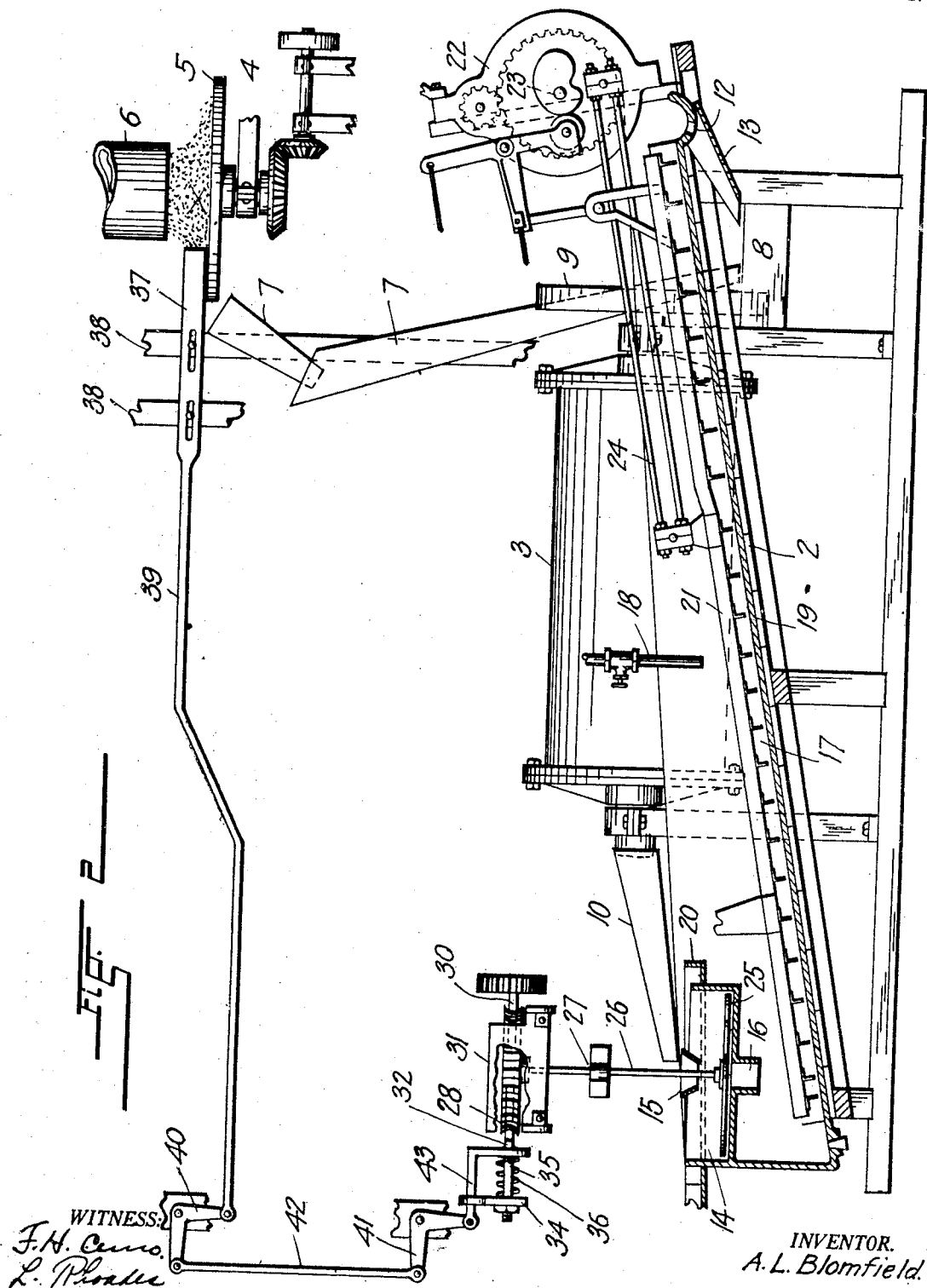
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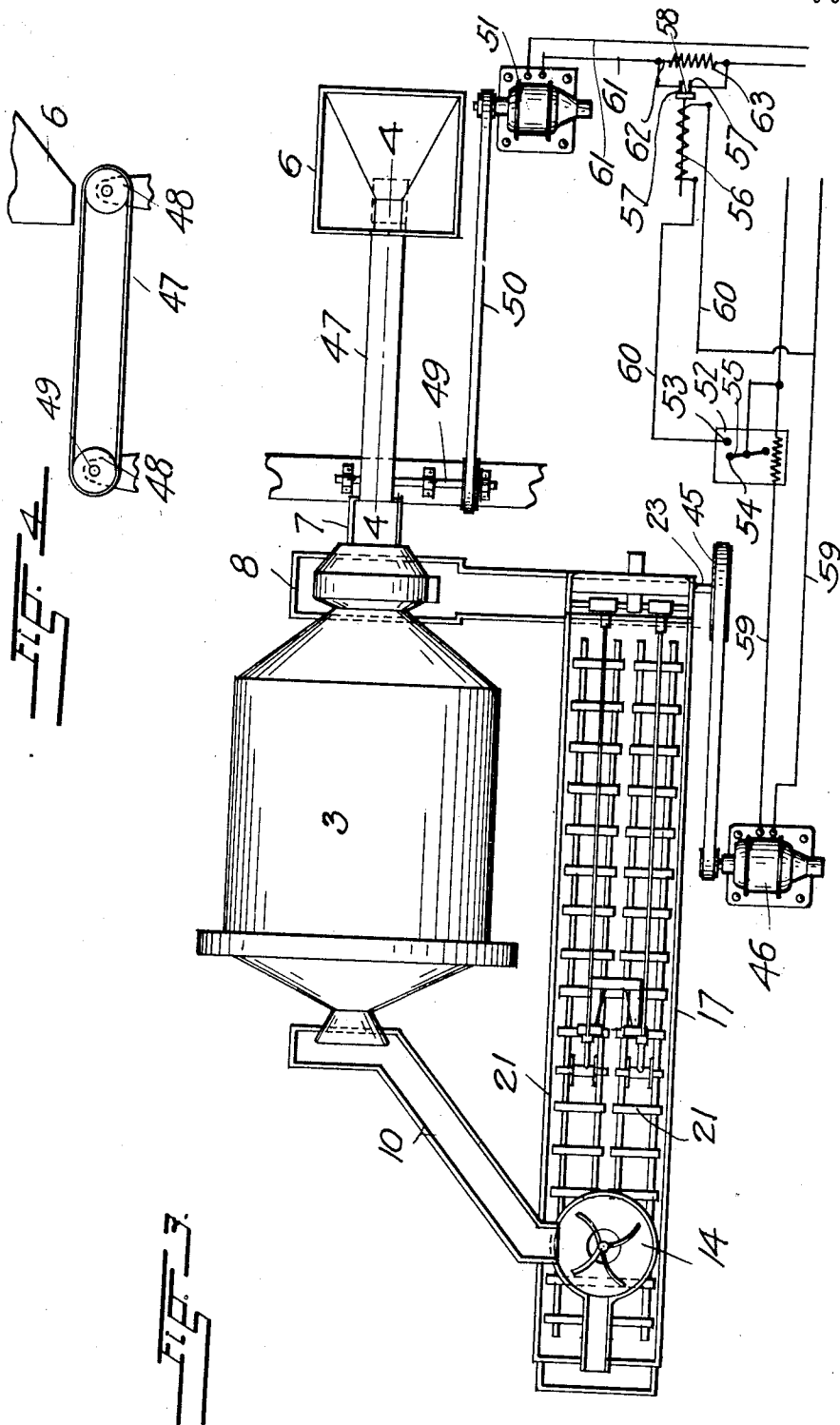
Patented Feb. 18, 1919.
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3 SHEETS—SHEET 3.



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UNITED STATES PATENT OFFICE.

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ORE-TREATING APPARATUS.

1,294,864.

Specification of Letters Patent.

Patented Feb. 18, 1919.

Application filed August 27, 1917. Serial No. 188,468.

To all whom it may concern:

Be it known that I, ALFRED L. BLOMFIELD, a subject of George V, King of England, residing at Denver, in the county of Denver and State of Colorado, have invented certain new and useful Improvements in Ore-Treating Apparatus, of which the following is a specification.

This invention relates to improvements in ore-treating apparatus, its primary object being to provide in a closed circuit grinding system, means to automatically regulate the feed of fresh material in proportion to the resistance presented by the material under treatment, to the movement of the operative parts of the apparatus included in the system.

It is a well-known fact that in the present method of grinding ores in a closed circuit, the return feed to the grinding mill outweighs the original feed several times and that this return feed unless carefully regulated, is liable to exceed the maximum capacity of the mill.

As the load increases, the resistance to the movement of the operating parts of the mechanism by which the alternate classification and grinding of the ore is effected, increases proportionately, and in the present invention advantage is taken of this definite factor to automatically regulate the original feed to the mill and thereby maintain the circulating load at or near the point of its greatest efficiency.

The closed circuit to which my invention is more particularly applicable, includes a classifier, a grinding machine, a device for feeding fresh material into said machine, a conveyance for the discharge from the grinding-mill to the classifier, and a conveyance for returning the oversize from the classifier into the mill.

The separation of the sizes is obtained in the classifier by the subsidence of the heavier and coarser particles out of the liquid mass, while the fines are held in suspension and removed by overflow.

The settling matter is moved to a point of discharge by the action of a rake or other suitable mechanical contrivance and it is by the resistance to the operation of this contrivance that in the preferred form of my invention, the original feed to the grinding mill is regulated.

It will be readily seen that the regulation

of the feed to the mill in order to avoid a load exceeding the capacity thereof, affords the opportunity of constantly maintaining the mill at or near the point of its greatest efficiency; that the regulated feed to the mill produces a regulated feed to the classifier and that in consequence the efficiency of the classifier and the uniformity of its product are likewise promoted.

In the accompanying drawings I have shown two methods of attaining the above described objects either mechanically by an association of cooperative mechanical devices, or electrically by the use of automatically operating circuit-controlling appliances.

I desire it understood, however, that my invention is not limited to the use of any particular device or devices to accomplish the desired result inasmuch as the construction and arrangement thereof is subject to many variations and modifications not only by reason of the wide range of appliances which are suitable for the purpose, but also on account of the differences in the construction and arrangement of the elements of which the milling plant is composed.

In the drawings in the various views of which like parts are similarly designated,

Figure 1 represents a plan view of a closed circuit grinding system showing the method of applying my invention by mechanical means,

Fig. 2, a sectional elevation on a plane indicated by the line 2—2, Fig. 1,

Fig. 3, a plan view of the system showing a method of applying my invention by the use of an association of electrically controlled devices, and

Fig. 4, a section taken along the line 4—4, Fig. 3.

Referring first to Figs. 1 and 2 of the drawings the reference character 2 designates a classifier the construction of which will be hereinafter more fully described, 3 a grinding machine of the ball- or tube-mill type, and 4 a feeding device consisting of a rotary disk 5 mounted beneath a supply-hopper 6.

The material discharged from the disk of the feeding apparatus is conveyed through a pair of chutes 7 into a box 8 from which it is lifted into the ball-mill by means of a rotary scoop 9.

The ground product of the mill is by

means of a chute 10 conveyed to the feed end of the classifier and the coarse product or oversize discharged from the latter through an outlet 12, is by means of a chute 5 13 returned to the box 8 and fed into the ball-mill with the material delivered by the feeding apparatus.

I desire it understood that the system of devices shown in the drawings and herein 10 described, is merely illustrative of one of the many uses to which my invention may be employed, and that the effective operation of the automatic feed regulating appliance hereinafter to be described is independent of the specific construction or coöperative 15 relations of the devices with which it is associated.

The classifier hereinbefore referred to, consists of a primary settling chamber 14 20 into which the matter discharged from the ball-mill is fed through the medium of a distributing box 15.

The settling chamber is preferably composed of a cylindrical vessel having a moderately sloping bottom.

A launder 20 placed around the edge of the circumferential wall of the vessel, receives the liquid and suspended material which in the operation overflow said edge, 30 and a passage 16 in the center of the sloping bottom of the container, discharges the settling coarser constituents of the material into the subjacent end of a trough-like box 17 which constitutes the secondary settling 35 and dewatering chamber of the classifier.

The bottom 19 of the trough slopes from its feed-end upwardly to a point above the liquid level, determined by the overflow of the initial settling chamber, and a conduit 40 18 supplies in the operation, liquid to the trough for the purpose of producing a counter-current which returns the fines rising out of the material in the secondary chamber, into the primary chamber for reclassification 45 and thus assists in effecting a clean separation of the two classes into which the ore-pulp is divided.

Suitable mechanisms are provided to mechanically impel the material across the bottom 50 of the chamber 14 toward the outlet 16 and along the sloping bottom of the trough 17 toward the outlet 12 which connects with the chute 13.

The mechanism for moving the material 55 upwardly along the bottom of the dewatering chamber, consists in the construction shown in the drawings, of a pair of rakes 21 which are suspended for reciprocation and which are coöperatively connected with a 60 crank-wheel 22 on a driving shaft 23 by means of a pitman 24.

The mechanism which impels the material settling in the chamber 14, across the bottom thereof toward the passage 16, is composed

of a series of sweeps 25 projecting from the 65 lower end of a shaft 26 which is rotatably supported in boxes 27.

The shaft 26 is in the operation of the classifier slowly rotated by a worm movement consisting of a toothed wheel 28 and a 70 worm 29 on a transversely extending shaft 30, which meshes with said wheel.

For the purpose of adapting the driving mechanism of the shaft for the actuation of the automatic feed-regulating appliance, the 75 usual thrust bearing of the worm shaft is replaced by a bearing 31 which supports the shaft for rotation and permits of a limited longitudinal movement of the same.

The worm-shaft engages at one of its ends 80 with the head 32 of a thrust-block 33 slidably mounted with relation to an abutment 34 which by means of bolts 35 is connected with the bearing 31 which supports the worm-shaft.

A coiled-spring 36 disposed between the 85 sliding thrust block and the abutment, provides a resilient element which yieldingly opposes endwise displacement of the worm-shaft when the resistance offered by the settled material on the bottom of the chamber 14 to the rotary movement of the sweeps, increases beyond a predetermined degree.

It is this resistance to the operation of the mechanism provided to impel the material 95 settling upon the bottom of the primary settling chamber, toward the outlet of the same, that is utilized for the operation of the appliance which automatically regulates the feed to the grinding mill.

This appliance consists in its preferred 100 form, of a baffle 37 which extends above the rotary disk 5 of the feeding device and which is mounted for longitudinal adjustment upon a suitable support designated in 105 the drawings by the reference numeral 38.

The baffle is fixed at the end of a rod 39 which at its opposite extremity is pivotally 110 attached to one of a pair of bell-cranks 40 and 41 which are connected for synchronous motion by means of a rod 42.

The lower bell-crank of the pair is by means of a transverse arm 43, connected with the sliding thrust-block 33, with the result that when by an increased resistance to 115 the movement of the mechanism which impels the settling solids toward the front of the chamber 14, the worm-shaft is longitudinally displaced, the consequent movement of the thrust-block against the pressure of the spring, compels the connected bell-cranks to 120 turn about their respective axes, and causes the baffle to recede from the center of the feed disk.

The baffle serves in the operation of the 125 feeding mechanism, to obstruct the movement of the material delivered by the hopper 6 onto the rotating disk 5 and thereby com-

pels it to discharge over the edge of the disk into a chute 7. It will be readily seen that the quantity of material thus delivered from the feed-disk, varies in relation to the extent of the baffle above the same, and that by moving the baffle in the direction of the center of rotation of the disk, the quantity of material fed across the edge of the latter is proportionately increased.

10 In the operation of the classifier, the material subsiding in the primary settling chamber, congregates upon the bottom thereof in a semi-solid condition and is by the rotary movement of the sweeps 25, moved toward the passage 16.

15 If by an increased discharge of material from the grinding mill, the quantity of settling matter collecting on the bottom of the chamber 14, exceeds an amount predetermined by the tension of the spring 36, the consequent resistance to the rotary movement of the shaft 26 acts immediately upon the regulating appliance hereinabove described and causes the baffle to recede from the center of the rotating disk and thereby diminishes the feed into the ball-mill, in proportion to the excess delivered to the classifier.

20 In the form of my invention illustrated in Fig. 3, the feed to the ball-mill 3 is regulated by a system of electrical devices in proportion to the resistance of material settling to the bottom of the secondary settling chamber, to the impellent movement of the rakes 21.

5 The driving shaft 23 of the mechanism which imparts a reciprocating motion to the rakes, is provided with a pulley 45 for its connection with an electric motor 46.

The feed hopper 6 discharges onto the end of an endless belt-conveyer 47 mounted upon rollers 48 on a pair of shafts one of which 49 is by means of a belt 50 connected with a second electric motor 51.

An ammeter 52 connected in the circuit 59 of the first-mentioned motor, has a circuit-breaking appliance including a stationary contact 53 and a blade 54 adapted to be moved into engagement therewith by the movement of the hand 55 when the amperage of the current passing through the circuit exceeds a predetermined amount.

The blade and the contact of the circuit-breaker are connected at opposite sides of a break in a shunt 60 of the main circuit which controls the operation of a second circuit-breaker which in its preferred form consists of a solenoid 56 and a pair of contacts 57 which under normal conditions are electrically connected by a bridge 58 on the reciprocating armature thereof.

The contacts are connected at opposite sides of a break in the circuit 61 of the motor 51 which impels the feed-belt.

This circuit includes a shunt 62 which is

connected to afford a passage of current around the break in the main circuit and which contains a resistance-coil 63.

When by an over-accumulation of settled matter on the bottom of the secondary settling chamber, the resistance to the driving action of the motor 46 is increased, the consequent rise in amperage of the current which operates the motor will cause a movement of the hand 55 of the ammeter, with the result that the therewith associated circuit-breaker completes the shunt-circuit 60 in which it is connected.

The closing of the shunt circuit energizes the solenoid of the second circuit breaker which by the movement of its armature disconnects the contacts 57 and thereby discontinues the current flow through the line of the circuit of the motor 51 which operates the feed-belt.

85 The current is thus compelled to pass through the shunt 62 and the resistance coil 63 included therein with the result that the current-flow through the motor 51 is retarded.

90 The reduced current-flow lessens the rate of rotation of the motor shaft and thereby retards the movement of the feed-belt and proportionately reduces the feed into the ball-mill.

95 Having thus described my invention and the simple illustrative methods of carrying it into effect by either electrical or mechanical means, it will be readily understood that these means may be varied in construction and relative arrangement in accordance with the character and construction of the apparatus to which the feed-regulating contrivance is applied.

100 Having thus described my invention, what I claim and desire to secure by Letters-Patent is:

1. The combination with apparatus for comminuting and classifying ores, connected in a closed circuit, of mechanism for regulating the feed to said circuit by a resistance of the oversize of material under treatment, to its movement in said circuit.

2. The combination with apparatus for comminuting and classifying ores, connected in a closed circuit, of mechanism for regulating the feed to said circuit in proportion to the resistance of the oversize of material under treatment, to its movement in said circuit.

120 3. The combination with apparatus for comminuting and classifying ores, connected in a closed circuit, of mechanism for reducing the feed to said circuit, in proportion to the resistance of the oversize of material under treatment, to its movement in said circuit, said mechanism including means for deferring its operation until the resistance has increased beyond a predetermined degree.

4. The combination with an apparatus for the comminution of ores, and an appliance for feeding material thereto, of means to effect a return flow of an oversize of material under treatment, to said apparatus, and mechanism for regulating the feed by said appliance, by a resistance of the oversize to its said return movement.

5. The combination with a grinding-mill and a classifier connected in a closed circuit, an appliance for feeding material to said circuit, and means to effect the return flow of material discharged from the classifier to the mill, of mechanism regulating the feed by said appliance, by a resistance of said discharge to its said return movement.

6. The combination with an apparatus for the comminution of ores, and an appliance for feeding material thereto, of means to effect a return flow of material discharged from the apparatus, and mechanism for regulating the feed by said appliance, by a resistance of the discharge to said return movement.

7. In combination, a grinding mill and a classifier connected in a closed circuit, said

classifier including an overflow for fines, an appliance for feeding material to said circuit, impellent mechanism to effect the movement of the oversize toward the mill, and means for regulating the feed by said appliance in proportion to a resistance presented by the oversize to the operation of said mechanism.

8. In combination, a grinding mill and a classifier connected in a closed circuit, said classifier including an overflow for fines, an appliance for feeding material to said circuit, impellent mechanism to effect the movement of the oversize toward the mill, and means for reducing the feed by said appliance in proportion to the resistance presented by the oversize to the operation of said mechanism after said resistance has increased beyond a predetermined degree.

In testimony whereof I have affixed my signature in presence of two witnesses.

ALFRED LESLIE BLOMFIELD.

Witnesses:

A. D. FREEDMAN,
L. RHOADES.