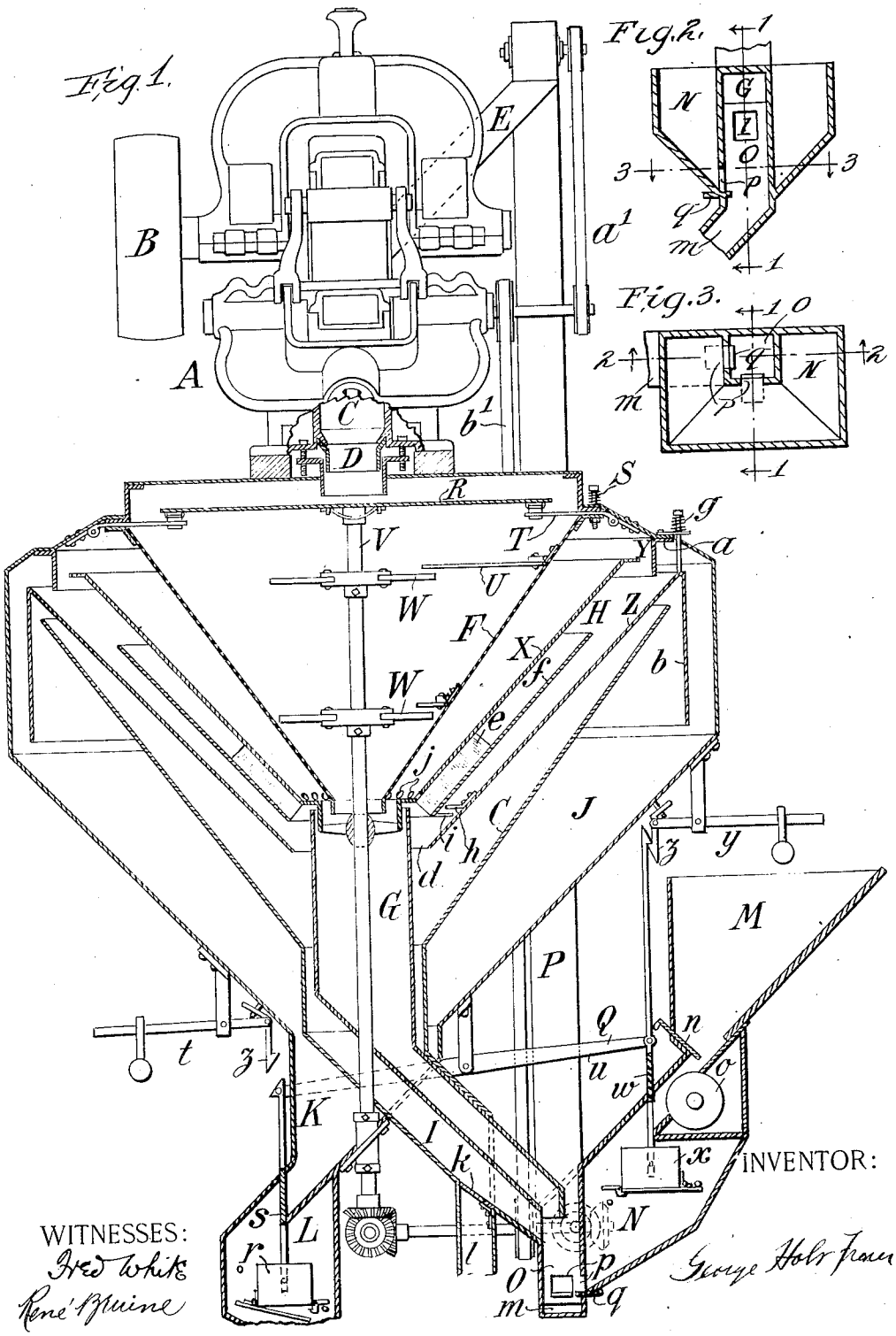
G. H. FRASER.

METHOD AND APPARATUS FOR TREATING PULVERIZED MATERIAL.

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1,385,674. Patented July 26, 1921.



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METHOD AND APPARATUS FOR TREATING PULVERIZED MATERIAL.

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To all whom it may concern:

Be it known that I, GEORGE HOLT FRASER, a citizen of the United States, residing in the borough of Brooklyn, county of Kings, city and State of New York, United States of America, have invented certain new and useful Improvements in Methods and Apparatus for Treating Pulverized Material, of which the following is a specification.

This invention relates to means for treating finely divided material, or mixtures of various pulverized substances, and to grinding, screening and mixing the same, and aims to provide improved methods for such treatment, and improved means especially applicable to carrying out the improved methods provided.

Heretofore it has been common to pulverize mixed materials of different physical characteristics or different specific gravity, to grade the material according to size so that material too large for pulverizing should be separated from that to be fed to the pulverizer, and that sufficiently pulverized should be separated for subsequent treatment. Ordinarily a coarse screen or grizzly is used to remove the coarsest material, and a fine screen or air separator is used to extract the powder, the intermediate material being returned to the pulverizer for further screening. The coarse screen is used to prevent the coarser material from wearing the finer separator, and its product may be mixed with the reject of the latter for return to the pulverizer after the fine separator has operated on the material.

The coarse material or mixture is supplied from a bin or suitable source, and the fine material is removed as made to a bin or suitable discharge. The various successive operations are effected by suitable apparatus arranged in the desired order and connected by any usual means for delivering from one to another.

In such operations difficulties have arisen from the liability of the mixture to change in proportions at different times, especially when one ingredient is lighter than another or of different physical characteristics. This changing of the relative percentages of the different materials in the mixture affects the chemical qualities of the mass, and where subsequent chemical treatment is required it is very disadvantageous.

In pulverizing, difficulty sometimes results from the liability of material of intermediate fineness occurring in irregular quantities, and variations in the proportions of coarse material and intermediate material injuriously affect the operation of the apparatus, as well as causing variations in the proportions of the mixture.

This invention aims to provide a method whereby material can be pulverized without materially altering the character of the mixture, whereby pulverization can be effected with great uniformity, and whereby the operation of pulverizing material may be automatically regulated by the material being treated.

It also aims to provide improved apparatus for pulverizing, separating and treating finely divided material or mixtures.

To this end in carrying out the preferred form of the improved process, the pulverized material is withdrawn from treatment as finished in quantities corresponding with the quantities of fresh material introduced for treatment, the proportions being continuously maintained so that the material under treatment shall always be under uniform conditions, and the introduction of new material is automatically controlled by the presence of intermediate material, so that while intermediate material is present in the system to the desired extent, the supply of fresh material is controlled by it to the extent desired to insure the finishing of the intermediate material present before ingress of fresh material. The escaping finished material controls the supply of fresh material, and the intermediate material present regulates the entrance of fresh material. The effect of this is that the quantity of material being treated is maintained so uniformly that substantially the same conditions prevail throughout treatment, and its treatment must be completed before additional material can enter, thus precluding important changes in the percentages of the materials constituting the mixture, since the charge under treatment must be disposed of before additional material can be treated, while the material as finished is continuously withdrawn and is continuously replaced by the automatic control of the fresh supply.

Where the separation of finished material is effected by a fluid current or air separator and the materials differ greatly in specific gravity, this precaution against changing of the mixture is especially important, as in

such instances the air separation would tend to remove the lighter material from the heavier regardless of fineness, in case a continuing supply of material were available before all of the material present had been pulverized.

This invention also provides improved means for carrying out the improved process, which means preferably comprise a pulverizer, a coarse screen, a fine separator, a supply bin, an elevator, and means connecting these parts in succession to effect the desired results.

In the accompanying drawings Figure 1 shows the preferred utilization of the improved process, and the preferred embodiment of the improved apparatus, and is a vertical axial section of a pulverizing, screening, separating, feeding and discharging system especially applicable for carrying out these improvements, the view being cut approximately on the line 1—1 of Figs. 2 and 3 and looking in the direction of the arrows; Fig. 2 is a fragmentary vertical section thereof cut at right angles to Fig. 1 approximately on the line 2—2 of Fig. 3 and looking in the direction of the arrows, and Fig. 3 is a fragmentary horizontal section thereof cut approximately on the line 3—3 of Fig. 2 and looking in the direction of the arrows.

Referring to the drawing, A indicates a pulverizer, B a drive pulley therefor, C the grinding chamber thereof, D the outlet conduit thereof, E the inlet conduit thereof, F a coarse screen, G its tailings spout, H an air separator, I its tailings spout, J its fine chamber, K its fine spout, L the fine discharge, M the coarse rock supply or feed bin, N the feed hopper, O the feed regulating or controlling chamber, P the elevator or other means communicating between the parts O and E, and Q the supply regulator.

The parts of the device shown may be of any suitable or usual construction and connected in any desired order or manner, but it is preferred to use a pulverizer of the ring and roll type in which the material is centrifugally carried by the ring and free to discharge therefrom regardless of the fineness of the material, and to drive the pulverizer from a suitable source of power, and to drive the other parts from the pulverizer, connecting the parts in succession so that the operation of all will be coincident.

As shown, the coarse screen or grizzly immediately succeeds the pulverizer, and is disposed below the latter to receive the discharge therefrom, having a revolving distributing disk R on which this discharge falls and by which it is thrown centrifugally to the outer upper edge of the screen, which is a vibratory non-rotative member.

It is preferable to construct the screen in the shape of an inverted cone elastically suspended from above by a spring S, so that it may descend under load or shock and will rise when released, and its upward movement will be suddenly arrested to give it a vibration or upward bump to jar material out of its meshes. A lever or arm T hinged to the casing *a* above the screen and in the path of a projection on the disk R serves to depress the screen when struck by the disk, thus vibrating the screen.

Preferably the screen is provided with swinging or spring strikers U, shown as both extending toward the shaft V of the disk R and movable into the path of swinging hammers W thereon, so that they will be struck thereby when the screen is depressed to agitate it for cleaning.

The screen F is preferably extended within and discharges its fines onto the inner face of a revolving distributer X, which is preferably an inverted cone mounted on and revolving with the shaft V, and having an outlet surrounding and spaced apart from the outlet of the screen F. The distributer X revolves with sufficient speed to raise and distribute over its upper edge the material fine enough to pass the screen F, which material is thrown against a deflector Y, from which it falls onto the receiving cone Z of the air separator, crossing the outlet thereof, so that the outflowing air current can blow the powdered material of desired fineness out of the falling material and into the settling chamber J of the air separator, the air from which returns within the apron *b*, over the tailings cone *c*, through the outlet *d* of the receiving cone, to the blades *e* of the blower *f*, which latter is a conical wall surrounding the cone distributer X and revolving therewith, and having radial blades between its inner face and the adjacent face of the distributer. The receiving cone Z is yieldingly supported by springs *g* so that it can be depressed until its inner projections *h* are brought into the path of revolving strikers *i* to jar it.

The tailings cone *c* communicates with the cylindrical upper end of the spout I, which end surrounds and is concentric of the coarse spout G, which latter receives the coarse material from the coarse screen F. The distributer X has bottom outlets *j* for any material failing to rise in the distributer, so that this material may drop through the bottom of the distributer and into the receiving cone Z and flow through the bottom outlet *d* thereof to the spout I. All material too large to be floated slides down the receiving cone Z and escapes through its outlet to the spout I.

The spout G discharges above and preferably vertically down through the material being discharged from the spout I, which latter discharges laterally into the regulating chamber O. If it is desired to use the

material flowing through the spout I, instead of to further grind it, the door *k* in the bottom of this spout is turned up so as to let the material in the spout I escape through the chute *l*, but if this material is to be reground, this door is closed as shown and the material enters the regulating chamber with the coarse material from the spout G.

The regulating chamber O discharges its material through a bottom outlet *m* to the boot of the elevator P, which raises the material to the feed inlet E, so that there is an endless circuit communicating through the pulverizer, the screen, the separator, and the elevator back to the pulverizer, through which the coarse reject from the screen and the intermediate reject from the separator may be continually re-fed to the pulverizer, so that this material will be reground.

The fine material settling in the dust chamber J flows into its spout K and escapes therefrom to the fine bin L.

The fresh feed from the chamber M flows past a gate *n* and a rock crusher or crushing roll *o* to the feed chamber N, from which it passes through outlets *p* to the regulating chamber O. These outlets preferably have adjustable lips *q* within the chamber O which extend inwardly, so that the angle from the top of the outlet *p* to the edge of the lip or shelf *q* is adjustable to control flow of the material escaping from the feed bin. The feed bin surrounds one or more sides of the regulating bin and has several outlets thereto, preferably one on each of two sides, for example as shown in the drawings wherein the chamber or bin O is shown as a vertically extending pipe or tubular member having an imperforate wall opposite each outlet *p* from the fresh feed hopper N, the openings *p* entering the bin O laterally intermediate of its bottom outlet *m* and its upper superposed fine and coarse tailings inlets I and G.

The regulating bin is similar to a vertical conduit or chute, and its inlet for intermediate and coarse material is above the inlets for fresh material, and its outlet is below these inlets. The intermediate material falls into the regulating chamber, and if it is not removed through the outlet therefrom by the elevator as rapidly as it enters, it fills up this chamber until it rises above the outlets *p* of the feed bin, whereupon the intermediate material in front of these outlets arrests flow of fresh material from the feed bin, which it does by closing the outlets therefrom. The removal of the intermediate material below these outlets permits this flow to automatically occur until it has sufficiently filled the regulating chamber to again prevent inflow thereto. The removal of material by the elevator through the outlet from the regulating chamber progresses uniformly, and so long as there is any material in the regulating chamber above the fresh feed outlets, entrance of fresh feed is prevented. The supply of intermediate material thus controls ingress of fresh material, and in this manner the continual grinding of intermediate material is insured, so that all intermediate material except the minimum necessary to control fresh feed will continue to be carried through the circuit of the system until it is pulverized before additional fresh material can enter.

In this manner it is assured that the charge of material being treated will be finished before more material can enter, and the excessive removal of a lighter ingredient from the mixture by the air separator will be precluded, since the heavier ingredients left in the system will prevent infeed of fresh material until the air separator has removed a sufficient quantity to permit the infeed of fresh material to automatically resume.

Should the escape of finished material be uninterrupted, the entrance of fresh material can be automatically controlled by the arrangement described, but it is preferred to further insure that the fresh material supplied to the system shall accord with the removal of finished material therefrom. This preferably is accomplished by utilizing the weight of fine material removed to control the supply of fresh material to the feed bin, and vice versa. As shown, the finished material spout K discharges into a weighing bucket *r* through a gate *s* which is controlled by a weighing device *t*, and this bucket and gate are connected by a lever *u* with a gate *w* and a bucket *x* for the feed bin, which are controlled by a weighing device *y*. The bucket *x* is shown as supported from its weighing device by the trip catch *z*, so that the gate *w* is open and fresh material for the feed bin is entering the bucket *x*. When the desired quantity has entered the bucket its weight tilts the beam until the trip catch releases, whereupon the bucket rapidly falls, lowering the gate *w* to prevent further infeed of fresh material, tilting the lever *u* to raise the bucket *r* and open the gate *s* until its trip catch *z* engages and supports this bucket, the bucket *x* dumping and the bucket *r* closing, all according to any well known method of automatic weighing, of which the parts illustrated are intended to be diagrammatic representations. The bucket *x* will discharge its weight load of fresh feed into the feed bin N and the bucket *r* will collect an equal load of finished material from the spout K, after which the operation will be reversed, the bucket *r* dumping its load into the fine bin L and closing the fine outlet and restoring the bucket *x* and opening the feed outlet.

As shown, the elevator is driven from the pulverizer by a belt a^1, and the distributer

for the coarse screen and blower for the air separator, as well as the feeder for the fresh rock, are driven by a belt b^1 therefrom, so that all movable parts of the system coincide with the pulverizer in operation, thus insuring stoppage of all in case of stoppage of the pulverizer, which prevents undue accumulation in any part of the system.

In this manner an automatic mechanical uniformity of supply and removal may be attained to prevent variations in operating conditions and minimize resulting changes.

In operating according to my improved process, one or several grades of the treated material, or of the material in process of treatment, will be utilized to control the feed of other grades of material or of fresh material, according to the requirements of the particular process or conditions of use. The coarser material being projected through the intermediate material, will materially reduce the tendency of the material to segregate according to size within the regulating chamber. The control of flow of the fresh or coarse material by the intermediate material will insure precedence to the latter in treatment, and greatly diminish tendency to variations in the percentage of ingredients in the mixture if a mixed material is being treated.

In using my improved apparatus the circular or conical vibrator movably and yieldingly mounted in the screen will be easily kept from clogging, and being nested or positioned within the conical redistributing disk, will occupy comparatively little space, and the distributing disk being likewise nested within the receiving cone of the air separator, and the blower of the latter being disposed in conical arrangement between the distributing cone and the receiving cone, will further minimize the space required for these several parts. The revolving striker in conjunction with the yielding and movably mounted receiving cone, will aid in keeping the cone clean, thus reducing the steepness necessary therefor.

It will be seen that this invention provides improvements in processes of treating materials which can be variously and advantageously availed of in whole or in part, and it will be understood that the invention is not limited to the particular details of arrangement, application or use set forth as constituting its preferred adaptation, since it can be employed in whole or in part according to such modifications and in connection with such devices as circumstances or the judgment of those skilled in the art may dictate, without departing from the spirit of the invention; and it will also be understood that the improvements in apparatus this invention provides are not limited to the particular details of construction, arrangement and combination set forth as constituting the preferred form thereof, since these improvements may be used in whole or in part according to such modifications as circumstances or the judgment of those skilled in the art may dictate, without departing from the spirit of the invention.

For example in practising the improved process it is not essential that the screen be either beneath or directly following the pulverizer, as any suitable means for communicating between the parts in any desired successive stage may be employed.

While these improvements in apparatus include in their preferred form screens and separators located next following the pulverizer, and circular or conical devices nested within one another for compactness, and having annular communicating ducts and contracting annular outlets, it will be understood that it is not essential that these be used in practising parts of the invention, since the elements may be individualized and connected in any suitable arrangement, or any suitable grizzlies or separators may be employed, if desired.

While the regulating hopper or bin is shown as disposed below all the parts and as feeding from its bottom to the mill through the medium of the elevator, and the plurality of hoppers or bins for different grades of material to be fed are shown as beneath the mill, and the feed bin as surrounding the regulating bin, instead of these parts being above the mill and the regulating bin discharging directly into the latter, it will be understood that the arrangement shown is not essential, being preferred for compactness and convenience of access, and that the plurality of bins may be located as desired, and the connections correspondingly arranged to dispose them in any manner so that feed to the pulverizer may be controlled by any of the several grades of material which it is desired shall govern the operation, the bins and their inlets and outlets being constructed and connected in proper manner to enable the grade of material which is to have precedence to interrupt or control the inflow of the other grade or grades.

What I claim is:—

1. The improved process of reducing material which consists in subjecting it to a crushing treatment, removing the material of the desired fineness as formed, separating the coarser material, again subjecting the separated material to crushing treatment, and utilizing the weight of such separated material to control entrance of fresh material to the mass.

2. The improved process of reducing material which consists in subjecting it to crushing treatment, removing the material of the desired fineness as formed, separating the

coarser material, again subjecting the separated material to crushing treatment, and utilizing the weight of the removed material to control entrance of fresh material to the mass.

3. In apparatus for grinding materials, a pulverizer, a separator, passages for fines, intermediate and coarse materials in communication with said parts, means operated by the weight of the fine material removed from said separator, means measuring the fresh material supplied to said pulverizer, and means controlled by said weight operated means and controlling the supply of fresh material to said separator.

4. In combination, means affording an endless path for material, means for returning coarse material to said path by gravity comprising a downwardly extending gravity chute or passage having an upper inlet and a confined downwardly extending chamber for such material and having a lower outlet, and having a lateral inlet in the side of said chamber for fresh material intermediate of said upper inlet and said lower outlet, and means for feeding by gravity fresh material to said path through said lateral inlet to said chamber laterally of the direction of flow of said coarse material therein.

5. In combination, means affording an endless path for material, means for feeding fresh material to said path, and means for returning coarse material to said path comprising a passage or chute having an upper inlet and a lower outlet in vertical alinement and having intermediate thereof a downwardly extending chamber between and in vertical alinement with said inlet and said outlet having a lateral inlet between said upper inlet and said lower outlet, and a gravity chute communicating with said fresh feeding means and discharging through said lateral inlet into said chamber.

6. In combination, means affording an endless path for material, means for feeding fresh material to said path, and means for returning coarse material to said path comprising a tubular member or spout having a lower outlet and having an upper inlet for said coarse material spaced above said outlet, and having intermediate of said lower outlet an upper inlet, a lateral gravity inlet communicating with said fresh feeding means, and having a wall opposite said lateral inlet for sustaining material descending through said member from said upper inlet against inflow of fresh feed through said lateral inlet.

7. In combination, means for feeding different grades of material comprising a downwardly extending chamber or chute having an upper inlet for material of one grade, a lower outlet, and intermediate thereof a confined chamber and a lateral inlet for another grade of material, and a second chute or member at the side of and communicating with the lateral inlet of said downwardly extending chute for feeding another grade of material laterally into the latter.

8. In combination, means for feeding material comprising a chamber or chute having a downwardly extending tubular portion having an upper inlet, a lower outlet, and having a downwardly extending chamber between said inlet and said outlet, and having a lateral inlet to said chamber below said upper inlet and above said lower outlet, a gravity chute communicating with said lateral inlet, and means for adjusting said lateral inlet to regulate flow through the latter.

9. In combination, means for producing pulverized material affording an endless circuit or path for material to be pulverized and comprising means having a vertically extending crushing chamber affording a complementary portion of such path constituting a downward way for such material and having a lower outlet, an air separator below and successive to said chamber and having a downwardly extending chamber affording a successive complementary portion of such path and a downward way for such material, and having means surrounding such way for freeing such material of fines, an elevator affording a complementary part of said path and having a lower inlet below and communicating with the outlet of such air separator for such material for receiving and elevating such material, and having an upper outlet above and communicating with such crushing chamber for delivering such material thereto, and means for operating said parts in correlation, and means for supplying material to be pulverized to such circuit.

10. In combination, means for producing pulverized material affording an endless circuit or path for material to be pulverized and comprising means having a vertically extending crushing chamber affording a complementary portion of such path ~~constituting~~ a downward way for such material and having a lower outlet, an air separator below and successive to said chamber and having a downwardly extending chamber affording a successive complementary portion of such path and a downward way for such material, and having means surrounding such way for freeing such material of fines, an elevator affording a complementary part of said path and having a lower inlet below and communicating with the outlet of such air separator for such material for receiving and elevating such material, and having an upper outlet above and communicating with such crushing chamber for delivering such material thereto, means for operating said parts in correlation, and

means for supplying material to be pulverized to such circuit controlled by such material therein.

11. In combination, means for producing pulverized material affording an endless circuit or path for material to be pulverized and comprising means having a vertically extending crushing chamber affording a complementary portion of such path constituting a downward way for such material and having a lower outlet, a separator below and successive to said chamber and having a downwardly extending chamber affording a successive complementary portion of such path and a downward way for such material, and having means surrounding such way for freeing such material of fines, an elevator affording a complementary part of said path and having a lower inlet below and communicating with the outlet of such air separator for such material for receiving and elevating such material, and having an upper outlet above and communicating with such crushing chamber for delivering such material thereto, means for operating said parts in correlation, and means for supplying material to be pulverized to such circuit as fines are separated from said separator.

12. In combination, means for producing pulverized material affording an endless circuit or path for material to be pulverized and comprising means having a vertically extending crushing chamber affording a complementary portion of such path constituting a downward way for such material and having a lower outlet, a separator below and successive to said chamber and having a downwardly extending chamber affording a successive complementary portion of such path and a downward way for such material, and having means surrounding such way for freeing such material of fines, an elevator affording a complementary part of said path and having a lower inlet below and communicating with the outlet of such separator for such material for receiving and elevating such material, and having an upper outlet above and communicating with such crushing chamber for delivering such material thereto, means for operating said parts in correlation, and means for supplying material to be pulverized to said circuit in like quantity of fines separated from said circuit.

13. In combination, means for producing pulverized material comprising means affording an endless path affording an inlet for material to be pulverized and an outlet for pulverized material and comprising means having a chamber affording a complementary portion of said path and constituting a way for material in said path, means for causing material to circulate through said path, means for withdrawing fine material from said path, means for progressing the residue of partially pulverized material in such path and past said inlet, means for supplying through said inlet fresh material to be pulverized, and means for causing such residue of unpulverized material in said path to control inflow through said inlet of such fresh material.

14. In combination, means for producing fine material comprising means affording an endless path affording an inlet for pulverulent material and an outlet for fine material and comprising a separator having a separating chamber affording a complementary portion of said path and constituting a way for material in said path, means for causing material to circulate through said path, means for withdrawing fine material from said path, means for progressing a residue of coarse material in said path past said inlet, means for supplying through said inlet additional pulverulent material, and means for causing such residue material in said path to control inflow through said inlet of such additional material.

15. In combination, means affording an endless path for pulverulent material affording an inlet and an outlet and comprising conveying means having a chamber affording a complementary portion of said path and constituting a way for such material in said path, means for causing material to circulate through such path, means for withdrawing from said path a portion of such material circulating through said path, means for progressing in said path the residue of such material therein past said inlet, means for supplying through said inlet additional material to said path, and means for causing such residue material in said path to control inflow through said inlet of such additional material.

16. In combination, means affording an endless path for pulverulent material affording an inlet and an outlet and comprising elevating means having a vertically extending chamber affording a complementary portion of said path and constituting a way for such material in said path, means for causing material to circulate through said path, means for withdrawing through said outlet a portion of such material from said path, means for progressing the residue of such material in said path past said inlet, means for supplying through said inlet additional material to said path, and means for causing such residue material in said path to control inflow through said inlet of additional material.

17. In combination, means for producing pulverized material comprising means affording an endless path for material to be pulverized, comprising a crushing chamber affording a complementary portion of said path and constituting a way for material in said path, an elevator for elevating mate-

rial in said path having a vertically extending chamber affording a complementary portion of said path and constituting a way for material in said path, means for causing material to circulate through said path, means for separating fine material from such material in said path, means affording an outlet for fine material from said path, means in said path between said crushing chamber and elevator affording an inlet to said path for additional material, means for progressing such residue of material in said path past said inlet, means for supplying through said inlet additional material to said path, and means for causing such residue material in said path to control inflow through said inlet of such additional material.

18. In combination, means for separating fine material comprising means affording an endless path for pulverulent material to be separated and comprising a separator having a separating chamber affording a complementary portion of said path and constituting a way for such material in said path, elevating means for elevating material in said path comprising a vertically extending chamber affording a complementary portion of said path and constituting a way for such material in said path, means for causing such material to circulate through said path, means affording an outlet for fine material from said path communicating with said path between said separator and said elevator for withdrawing from said path fine material separated from the material in said path, means affording an inlet to said path between said elevator and said separator, means for progressing the residue of such material in said path past said inlet, means for supplying to said path through said inlet additional pulverulent material, and means for causing such residue material in said path to control inflow through said inlet of such additional material.

19. In combination, means affording an endless path affording an inlet for pulverulent material and an outlet for fine material and comprising elevating means having a chamber affording a complementary portion of said path and constituting a vertically extending way for such material in said path, separating means for separating material from the material in said path having a downwardly extending chamber affording a complementary portion of said path and constituting a gravity way for downward flow of material in said path, means for progressing the residue of material in said path by gravity past said inlet for controlling inflow through said inlet, and means for introducing additional material into said path by gravity through said inlet.

20. In combination, means affording an endless path for pulverulent material and comprising elevating means for elevating such material having a vertically extending chamber affording a complementary portion of said path and constituting an upward way for such material in said path, separating means for separating coarse material from such material in said path having a chamber affording a complementary portion of said path and constituting a gravity way for material in said path, means between said elevating means and said separating means affording a conduit for coarse material affording a complementary portion of said path, means for withdrawing from said path the residue of such material in said path through said outlet, means for progressing such coarse material in said path past said inlet, means for introducing into said path through said inlet additional material, and means for causing such coarse material in said path to control inflow through said inlet of such additional material.

21. In combination, a separator for separating fine material from pulverulent material having an inlet and having an outlet for fine material and an outlet for coarser material, an elevator communicating between said latter outlet and said inlet for raising coarser material discharged through said latter outlet and returning it to said inlet, and means for feeding additional pulverulent material to be separated to said separator controlled by the material discharged through said outlet for coarser material.

22. In combination, a separator for separating fine material from pulverulent material having an inlet and having an outlet for discharging fine material and an outlet for coarser material, and means for feeding pulverulent material to be separated to said separator controlled by the fine material discharged through said outlet for fine material.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

GEORGE HOLT FRASER.

Witnesses:
FRED WHITE,
THOMAS F. WALLACE.