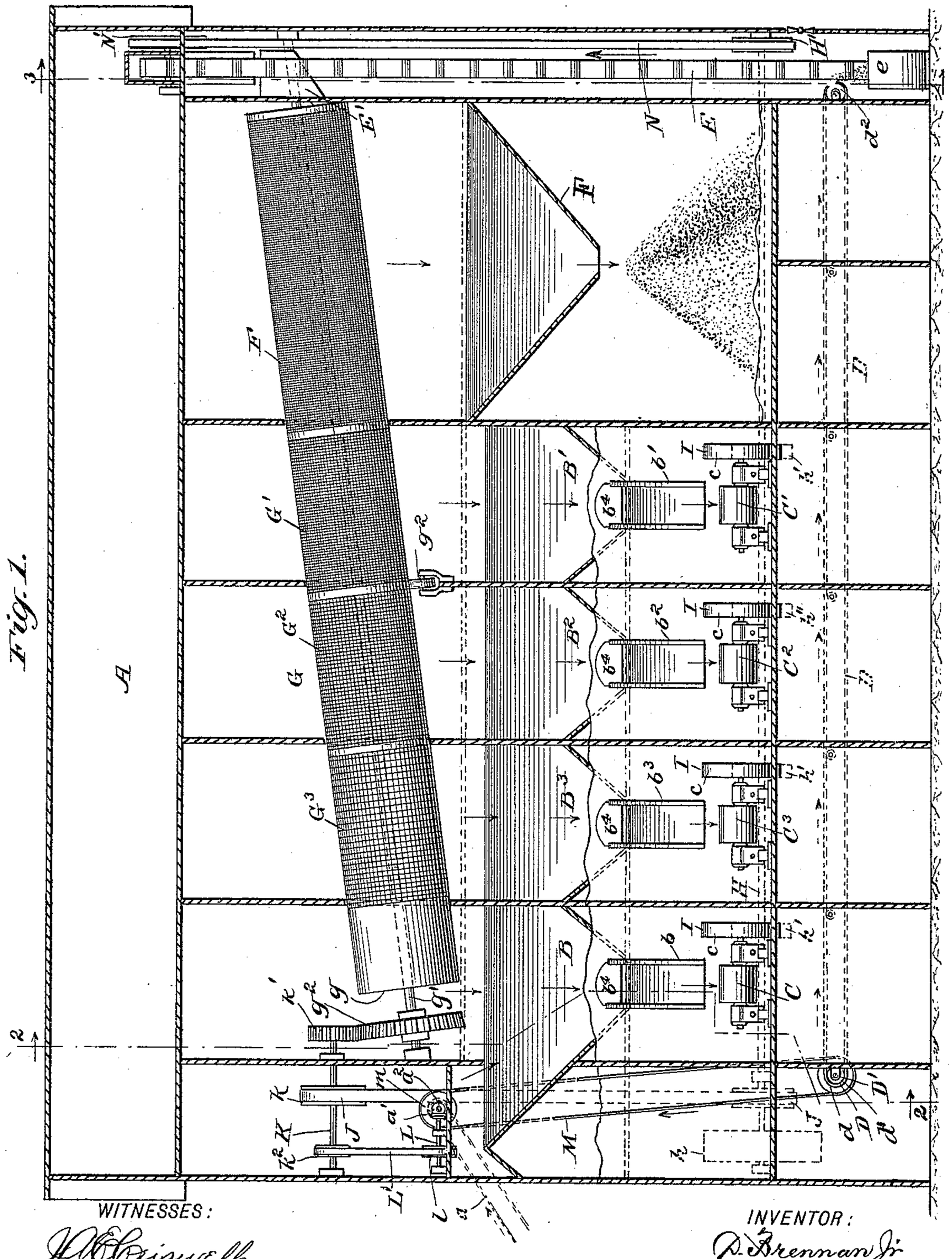
(No Model.) 2 Sheets—Sheet 1.

D. BRENNAN, Jr.

APPARATUS FOR REDUCING ORES.

No. 442,765. Patented Dec. 16. 1890.



(No Model.) 2 Sheets—Sheet 2.

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Fig. 3.

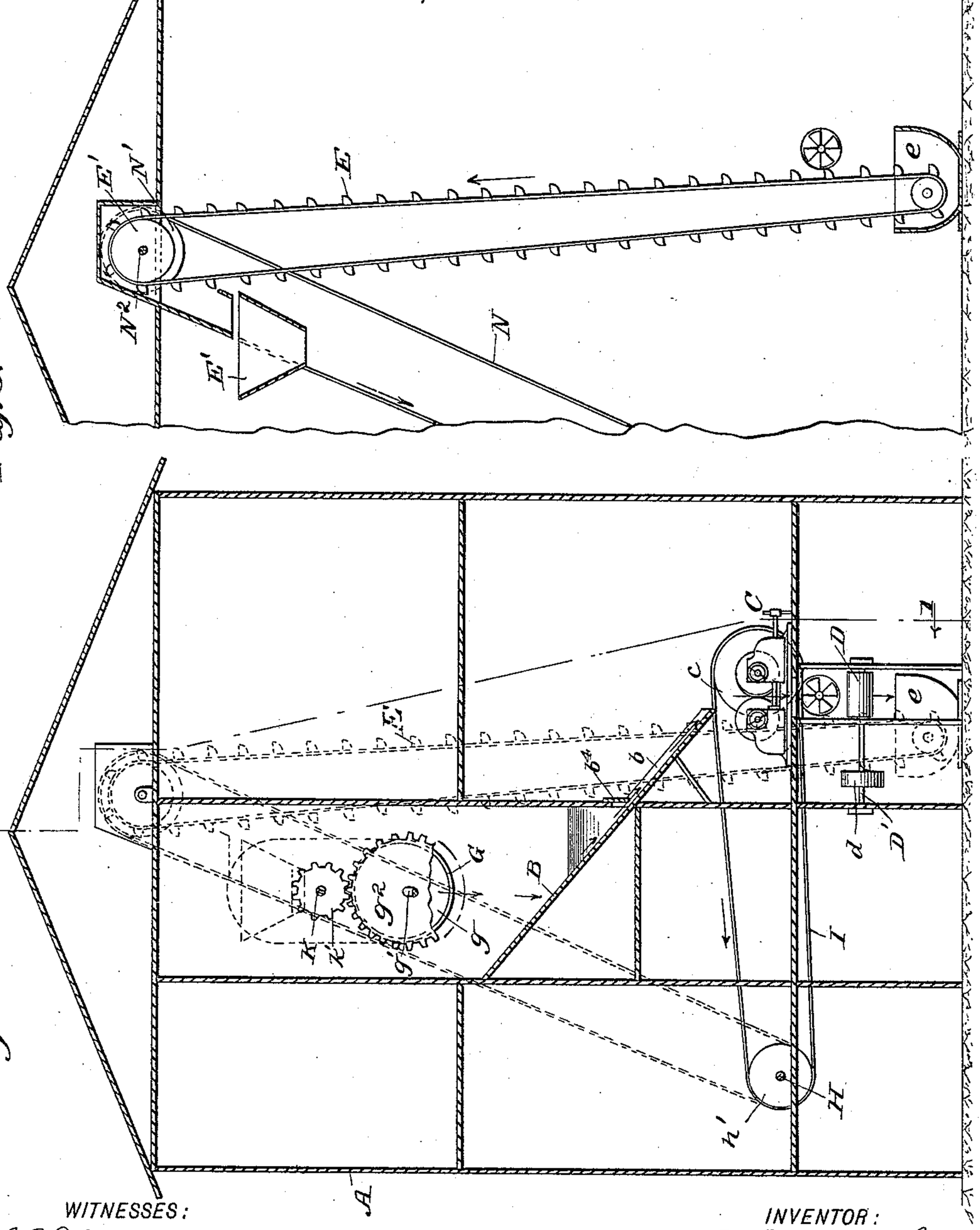

Fig. 2.

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APPARATUS FOR REDUCING ORES.

SPECIFICATION forming part of Letters Patent No. 442,765, dated December 16, 1890.

Application filed May 21, 1890. Serial No. 352,628. (No model.)

To all whom it may concern:

Be it known that I, DANIEL BRENNAN, Jr., of Bayonne, in the county of Hudson and State of New Jersey, have invented a new and Improved Apparatus for Reducing Ores, of which the following is a full, clear, and exact description.

In the reduction of ores by the gradual-reduction process as now generally practiced much waste of time and power is caused by simultaneously passing material of greatly varying sizes through the reducing-rolls; and the object of my invention is to effect a more economical and expeditious reduction of the ores by assorting the material after the initial breaking of the same, with special reference to the adjustment and capacity of the several reducing-rolls in the apparatus or system and feeding the material thus graded to the respective reduction-rolls.

The invention consists in the means hereinafter particularly described, and defined in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a longitudinal sectional elevation of an ore-reduction apparatus embodying my invention, the view being taken on the broken line 1 1 in Fig. 2. Fig. 2 is a vertical sectional elevation, the view being taken on the broken line 2 2 in Fig. 1; and Fig. 3 is a similar view on line 3 3 of Fig. 1.

In the building A, of suitable construction, is arranged the machinery for carrying out my invention. The material to be treated is received in the building A, after its preliminary or initial crushing and containing little or no finished product, from a carrier-belt, (indicated by dotted lines at *a* in Fig. 1,) or from any conveniently-located crusher, hopper, or other source of supply.

In the construction illustrated the carrier-belt *a* passes around a pulley *a'* on the short shaft a^2, delivering the material to a hopper B, to which a chute *b* is complementary, the said chute leading to a pair of crushing-rolls C. The rolls C, as also the other sets of rolls, hereinafter to be mentioned, are preferably of the adjustable variety and of the special construction illustrated and described in my application for United States Patent filed April 10, 1890, No. 347,337.

The product from the crushing-rolls C is received on a carrier-belt or conveyer D, which delivers to the boot *e* of an elevator E, the said elevator depositing the material into a chute E', arranged at the upper end of the elevator, which chute E' delivers the material to the finishing-screen F of the apparatus. The finishing-screen F is preferably of the rotary form and its mesh is of a degree of fineness to permit only the finished product to escape therethrough.

From the finishing-screen F the tailings pass either directly, as shown, or indirectly, to a separator and feed G, that supplies the material to a series of reduction-rolls C' C^2 C^3. The feed G consists of a series of graduated screen-sections G' G^2 G^3, that act to assort the tailings, feeding the same to the series of reduction-rolls C' C^2 C^3, the material being guided to the rolls from said graduated feed-screens by slides or hoppers B' B^2 B^3 and chutes *b'* b^2 b^3, complementary to said hoppers, sliding gates or doors b^4 being arranged to control the entrance to said chutes and regulate the flow of material fed to the rolls by the feed-screens G' G^2 G^3. Each set of reduction-rolls C' C^2 C^3 is adjusted with special reference to the grade of material delivered thereto by that particular section G' G^2 G^3 of the feed G that supplies the same. Any material too coarse to escape through the last section G^3 of the feed passes out from the end *g* thereof and is delivered through the hopper B and chute *b* to the first set of crushing-rolls C, to be reground with the incoming new material.

With the graduated screen-sections G' G^2 G^3, forming the feed for the various sets of rolls, as above described, only such material will be fed to each set of rolls as is best suited to the capacity and adjustment of said rolls, whereby the power of the rolls will be utilized to the maximum extent and the loss of power coincident to the operation of rolls under present methods obviated.

With material of a comparatively uniform size and rolls adjusted to correspond thereto, as above described, it is evident that the rolls will act directly and effectively to crush the material, whereas with material of greatly varying sizes the rolls must be adjusted with

reference to the larger fragments, with the result that much of the material passes through the rolls uncrushed, or practically so, power being uselessly expended thereby. Power is further uselessly expended by the rolls exerting more or less force in compacting the material preliminary to the actual crushing action, as the materials of mixed grades will be forced apart in proportion to the size of the larger fragments, so that it becomes necessary to feed heavily and depend mainly on the accidental crushing of the fragments by pressure among themselves, which indirect crushing is not as satisfactory or economical as could be desired. Further, the ungraded material is liable to offer uneven resistance at different points of the rolls, causing uneven wear and uneven action of the rolls.

The product of the reduction-rolls C′ C^2 C^3 is also received by the belt D and conveyed, together with the material from the roll C, by said belt and the elevator E to the finishing-screen F, the unfinished fragments or tailings being again received by the graduated feed G and by it again graded and fed to the respective rolls.

The finishing-screen F and the feed-screens are preferably arranged in a continuous series and supported on a common inclined shaft g', that is journaled in any suitable bearings, supporting-rollers g^2 being also provided at one or more points along the screens.

The main features of the apparatus—the rolls, conveyers, feed, &c.—are actuated in the arrangement shown as follows: The main drive-shaft H extends longitudinally in the building A, and is provided with a drive-pulley h, that is driven from any convenient power, and with pulleys h' in position to receive belts I, that actuate the drive-pulleys c of the several sets of rolls C C′ C^2 C^3. A belt J, also driven from the shaft H, extends upward to a pulley k on a short shaft K, on which shaft K is a pinion k', that meshes with a gear-wheel g^2 on the shaft g' of the screens. On the shaft K, also, is a second pulley k^2, from which extends a belt L′ to a pulley l on a short shaft L. The shaft L is geared to the short shaft a^2, on which is a drive-pulley m, from which extends downward a belt M to a pulley d on a short shaft D′. The pulley or roller d' on shaft D′ actuates and supports at one end the carrier-belt D, which, as previously explained, conveys the material from the crushing-rolls C and reduction-rolls C′ C^2 C^3 to the boot e of elevator E, the opposite end of the belt D being similarly supported by a pulley d^2.

From a pulley H′ on main drive-shaft H extends upwardly a drive-belt N to a drive-pulley N′ on a short shaft N^2, on which is also fitted the pulley or chain-wheel E^2, that drives the elevator E.

With an apparatus constructed as above described the material is treated as follows: It is first received from the conveyer-belt a in the hopper or slide B, passing thence by chute b to the set of crushing-rolls C, the product of said rolls being received by the belt D and conveyed to the elevator E, by which it is carried to the finishing-screen F. Any finished product will escape through the meshes of the finishing-screen F to the hopper F′ or to any chute, conveyer, or desired place of deposit. The tailings from the finishing-screen F pass to the feed G of the varying reduction-rolls C′ C^2 C^3, the finer products being fed by the screen-section G′ of feed G to the corresponding rolls C′, the slightly-larger fragments by the section G^2 of the feed to the rolls C^2, and so on, it being understood, of course, that the number of sets of reducing-rolls and their corresponding sections of the feed-screen may be multiplied to any desired practical extent, in accordance with the required degree of fineness of the product and the power of the several machines. The product of the reduction-rolls C′ C^2 C^3 is received by the belt D and conveyed, with the material from the rolls C, to the elevator E to be again passed to the finishing-screen F, and the tailings again received by the feed G and by it assorted and fed to the several sets of reducing-rolls.

With the above-described apparatus, the finishing-screen being common to all the rolls, a considerable amount of coarse material will be always present with the finished product on the way to the finishing-screen and in the latter and will act to agitate the finished product and materially facilitate its exit through the meshes of the said screen.

In reference to the finishing-screen it will be readily understood that an arrangement such as shown will be very practical and economical and possess the advantage that the said screen will receive the finished product in conjunction with grades of greatly-varying sizes, by reason of which the egress of the finished product will be greatly aided. The location and form of the finishing-screen may, however, be varied in practice, the generic feature of the invention being that the separator-screens are common to all the crushers or sets of rolls and receive back by a suitable conveying mechanism the unfinished product or tailings of each set of rolls and redistribute the said tailings graded to the rolls corresponding to the several sections of the separator-screen.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, in reducing apparatus for ores, of a series of crushers or reducing-rolls, a series of separator-screens common to all of said rolls, and conveying mechanism between the rolls and their said common separator-screens, the separator-screens forming the receiver for the coarse products or tailings of each of said rolls and forming a distributer for the delivery of said tailings again to the several rolls, substantially as described.

2. The combination, with a series of reduc-

ing-rolls, of a finishing-screen, a series of separator-screens, and conveying mechanism, substantially as described, the separator-screens forming a receiver of the tailings from the finishing-screen and forming a distributer of the said tailings again to the rolls to which it is common, as set forth.

3. In an apparatus for reducing ores, the combination, with a series of reducing-rolls or crushers, of a series of separator-screens for feeding graded material to the respective rolls, a finishing-screen, and conveying mechanism, substantially as described, said finishing-screen and conveying mechanism forming a conductor for the material from the several rolls to the common separator-screens, and the finishing-screen affording the only exit of the finished product from the apparatus, whereby the tailings resulting from all the rolls will be returned to the separator-screens and be again distributed to the rolls, substantially as described.

4. In an apparatus for reducing ores, the combination, with a series of reducing-rolls, of a finishing-screen affording the only exit from the apparatus of the finished product of the rolls, a series of separator-screens forming a receiver for the tailings from the said finishing-screen and forming a distributer for distributing said tailings to the rolls, and a conveying mechanism, substantially as described, common to all the rolls of the apparatus, the whole forming a continuous circuit for the unfinished material, substantially as described.

5. In an apparatus for reducing ores, a series of reducing-rolls and a finishing-screen common to all the said rolls for receiving both the finished and unfinished product thereof, in combination with a series of separator-screens for receiving the tailings of the common finishing-screen and forming a distributer of the graded tailings to the reducing-rolls, and conveying mechanism, substantially as described, completing the circuit from the rolls to the screens, substantially as described.

6. In an apparatus for reducing ores, a series of reducing-rolls and series of separator-screens common to all the rolls and to which the unfinished product of all the rolls in the circuit is delivered, said separator-screens forming a feed for feeding graded material to all of said rolls, in combination with a finishing-screen and a conveying mechanism completing the circuit between the rolls and the separator-screens, substantially as described.

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Witnesses:
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EDGAR TATE.