No. 696,604.

Patented Apr. 1, 1902.

A. H. STEBBINS.

ORE CONCENTRATOR.

(Application filed June 26, 1900.)

(No Model.)

2 Sheets—Sheet 1.

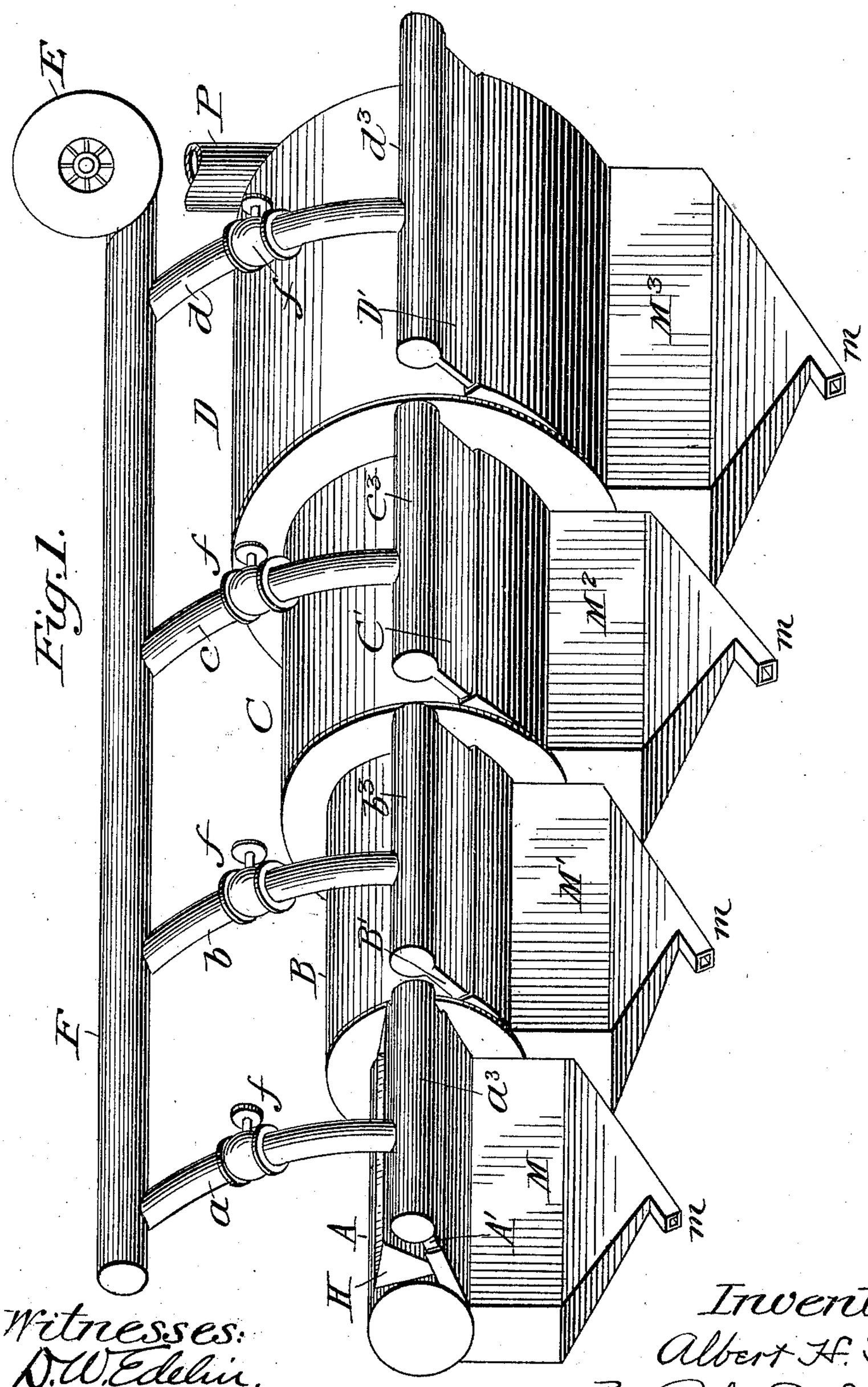

Fig. 1.

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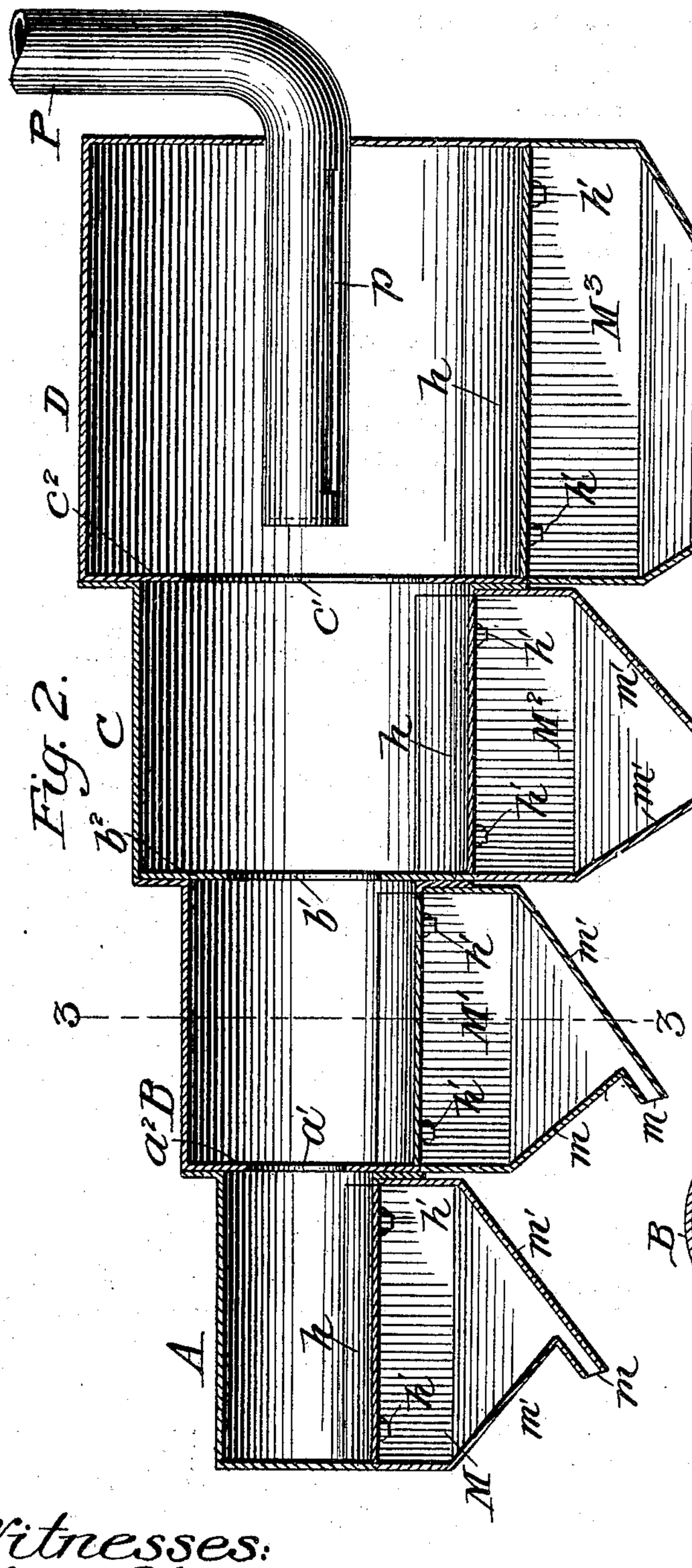

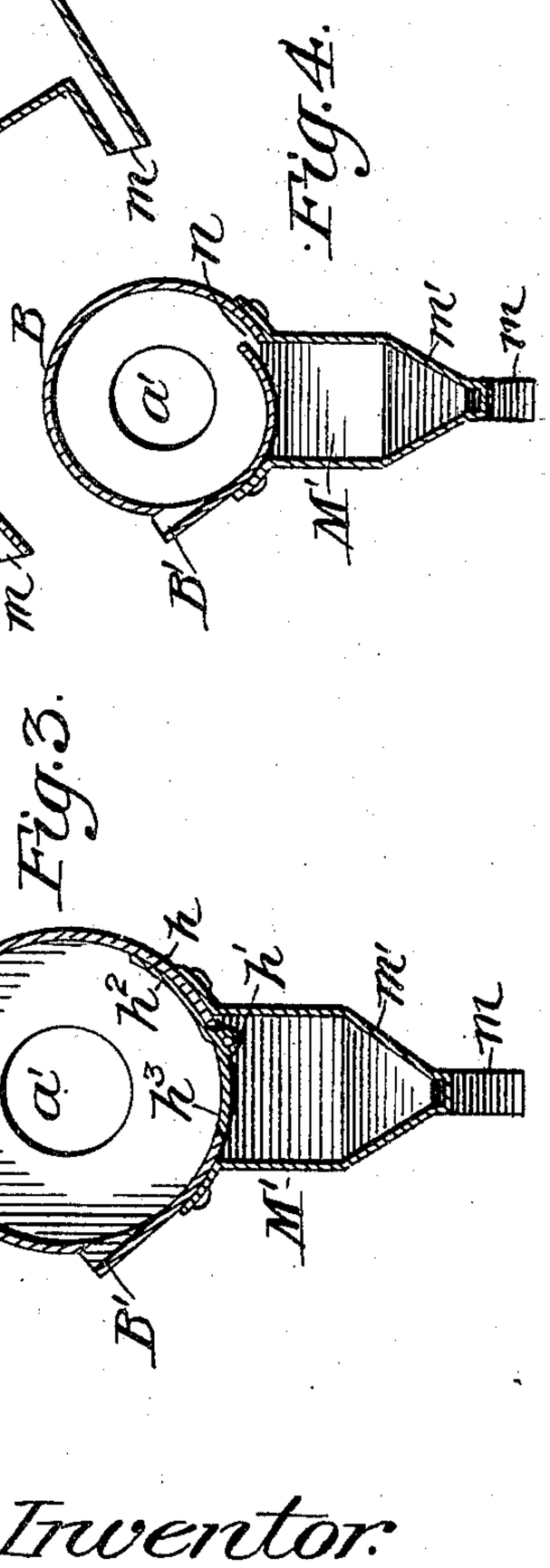

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UNITED STATES PATENT OFFICE.

ALBERT H. STEBBINS, OF LITTLE ROCK, ARKANSAS.

ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 696,604, dated April 1, 1902.

Application filed June 26, 1900. Serial No. 21,612. (No model.)

To all whom it may concern:

Be it known that I, ALBERT H. STEBBINS, a citizen of the United States, residing at Little Rock, county of Pulaski, State of Arkansas, have invented certain new and useful Improvements in Ore-Concentrators, of which the following is a specification.

The invention to be hereinafter described relates to ore-concentrators for separating the valuable portions of ores from their adhering impurities, and more particularly to that type of such machines wherein the different characters or qualities of ore-bearing particles are separated not only from the lighter impurities, but are graded according to their size or specific gravities.

It is a well-recognized fact that different minerals and often different combinations and mixtures of the same mineral when finely divided have different specific gravities and also many different shapes, some values being almost perfect cubes, some nearly round, others quite flat. In fact, they occur in a great variety of shapes and forms. In the ores of the precious metals—as, for instance, gold ores—the particles vary in shape and size between very wide limits, from those so small as not to be readily detected by the naked eye to those of considerable bulk, and all such variations in specific gravity and size of the particles of ore largely control the practical and successful handling of the material and its treatment.

It is the object of my present invention to provide a gradational concentrator that will be readily applicable to the successful treatment of a large variety of ores and which will separate the lighter impurities from the ore-bearing particles and divide the latter according to their size and specific gravity.

With the above general objects in view my invention consists of a series of drums, preferably, though not necessarily, cylindrical, into which the finely-divided ores are fed, a current of air or other fluid being introduced tangentially to the drums and gradually decreasing in force or velocity from one drum to the other throughout the series, whereby the heaviest particles or values of ore are first separated and led to a proper receptacle, then the next quality of particles or values are separated, and so on throughout the series; and the invention further consists of the parts and combinations, all as will hereinafter be fully described, and definitely pointed out in the claims.

In the drawings, Figure 1 is a perspective view of an ore-concentrator embodying my invention and arranged in the form of a series of drums connected end to end. Fig. 2 is a central longitudinal section of the same. Fig. 3 is a cross-section on the line 3 3 of Fig. 2, and Fig. 4 is a sectional view similar to Fig. 3, showing a slightly-modified form of discharge for the concentrates.

In the type of concentrator shown by the drawings a plurality of drums A B C D of any desired number and preferably of varying size are arranged end to end, the adjacent ends of the drums being open to provide free communication lengthwise of the drums throughout the entire series. Each drum of the series is preferably cylindrical in shape, though the form may be varied, and each drum is provided with an inlet A′ B′ C′ D′, respectively, extending preferably tangential to the drum and substantially throughout the length thereof, by which air or other fluid may be introduced to the drums in a manner to cause circular currents to sweep around the interior thereof. These several inlets are connected to any suitable device, as a fan or wheel E, through the supply-pipe F and branch pipes *a b c d*, by which means air or other fluid may be introduced into the several drums. I preferably form the drums of gradually-increasing size or diameter from one end of the series, as shown in the drawings, where the drum A at the left is the smallest and communicates at its open end *a′* with the next-larger drum B, which in turn communicates at its open end *b′* with the next-larger drum C, and it in turn communicates by its open end *c′* with the next-larger drum D. It will be noticed that between adjacent drums there is provided a flange, as a^2 b^2 c^2, respectively, which contracts the end opening between the drums and serves to prevent the too rapid passage of the particles from one drum to the other, as will hereinafter more fully appear.

Preferably mounted so as to communicate with the inlet A′ of the end or smallest drum A of the series is a feed-hopper H, by which

the comminuted or finely-divided ore or other substance may be introduced into the series of drums by the blast of air or other fluid coming from the supply-pipe F. While I have shown this form of feed for introducing the material to the drums for treatment, it is to be understood, of course, that such form of feed is not essential and that the material may be introduced in any desired manner without departing from the spirit of my invention.

At the end of the series of drums at B, opposite the smallest drum A, I preferably form an outlet for the light impurities separated from the ore, said outlet consisting of a pipe P, centrally arranged within the large end drum D of the series and having an opening *p* in its under surface. Such form of outlet is not essential, however, as any preferred or desired discharge for the air or fluid carrying the light valueless particles may be employed.

From the construction thus far disclosed it will be seen that the finely-divided ore is introduced and first subjected to the air or fluid currents in the smallest drum of the series and that the heaviest particles or values will fall and rest in the bottom of this drum, the lighter particles or values, along with the impurities, passing through the open end *a'* of this drum into the next-larger drum B, where the incoming blast of air or fluid will act upon the material to continue its circular movement; but the drum B being larger than drum A the force of the circular currents induced therein will be correspondingly decreased, thereby permitting many of the particles or values introduced from drum A to settle to the bottom of drum B, while those particles or values, together with the light impurities, still held in suspension by the reduced currents will pass through the opening *b'* into the drum C. The blast of the air or fluid in drum C acts upon the material entering from the drum B and continues its circular movement, but with a reduced force, owing to the fact that the drum C is larger than drum B, and by virtue of the reduction in the force of the current many particles or values held in suspension by the currents in drum B now settle to the bottom of drum C. This same action is continued through the entire series of drums, the currents in the successive drums permitting particles or values to settle corresponding to the force of the current—that is to say, particles or values which would be held in suspension and given circular movement by the great force of the circular currents in drum A would upon passing into the weakened currents of drum B settle to the bottom of the said drum, while those particles or values which are too light to settle in the drum B and are held in suspension by the force of the circular currents in said drum are carried into the next-larger drum C, where under the reduced or weakened influence of the currents in the next drum C they settle, and so on throughout any desired number of drums. When the material has passed through and deposited its particles or values, according to their size or specific gravities, in the several drums of the series, the lighter impurities are carried into the exhaust or outlet pipe P and from the machine, though such outlet-pipe may be dispensed with and the end of the cylinder left open, as is obvious. It will thus be seen that the process of separation goes on continuously throughout the series of drums and that the particles or values are divided and separated according to their size or specific gravities, each drum acting in turn to separate the values which are too large or of too high specific gravity to be kept in motion by the particular currents of air or fluid in the drum, and the flange between the drums by contracting the opening serves to retain the particles under the influence of the circular currents in any particular drum sufficiently long to insure the complete removal of the particles or values which the force of the current in the particular drum is unable to hold in suspension. In order to further insure the gradual reduction of the air-currents in the succeeding drums of the series, I form the air or fluid inlet to the first or smallest drum A larger than the inlets to the other drums and gradually reduce the size of the inlet-opening B' C' D', as clearly shown in Fig. 1, so that while the currents in drum A will be of maximum strength, owing to the size of the drum and the inlet-opening, the strength of the currents produced in the succeeding drums will be gradually reduced.

It will be noticed that I connect the supply-pipe F to the inlets to the several drums preferably by several separate branch pipes *a b c d*, in each of which I provide a valve *f*, whereby the force of the blast to any one drum may be varied and regulated as desired. Furthermore, it will be noted that at the upper end of each inlet A' B' C' D' is connected a small cross-pipe a^3 b^3 c^3 d^3, respectively, to provide for the more even distribution of the air or fluid to the several drums throughout their length.

Preferably each drum of the series is provided with a concentrate-box directly beneath the same, into which the particles or values that settle in any particular drum may be discharged and collected. These concentrate-boxes in the particular form illustrated comprise receptacles substantially the length of the drums, having their bottom walls inclined, as at *m'*, and terminating at their lower ends in a discharge-chute *m*. In Fig. 1 the concentrate-boxes for the several drums are indicated by M' M^2 M^3 M^4. Of course it will be obvious that the form of concentrate-box and discharge-chute may be varied as desired without departing from the spirit of my invention.

In order to provide for the discharge of the

cencentrates or values from the drums as they settle under the influence of the air or fluid currents, I provide each drum with a discharge-opening in the bottom thereof and preferably cover said opening by a door h, hinged at h' to the drum. The said doors are preferably coincident with the length of the drums and are pivoted at such point in their width as that they will remain normally closed—that is, the upper portion of the door h^2, which overlies the interior wall of the drum, overbalances the part h^3 of the drum, which covers the opening of the discharge-outlet in the bottom of the drum, so that said door will remain normally closed. It will be noticed also that the air or fluid inlet is directed toward the bottom of the drum, so as to cause the air or fluid currents to pass directly over the door h as they enter the drum. The effect of this is to prevent the lighter particles and valueless portions of matter from settling on the lower wing h^3 of the door and to insure their movement and circulation by the air or fluid currents. When sufficient of the values or particles of ore have settled on the door h of any one drum, they will rest mainly upon the lower wing h^3 thereof and by reason of their weight will automatically cause the outlet-door to tilt to permit the discharge of the particles or values into the concentrate-box beneath, whereupon the door will, by the preponderating weight of its upper wing h^2, be returned to its closed position. I prefer this automatic arrangement for the discharge-doors h for the reason that it obviates the necessity of attention on the part of the operative to dump the values or particles as they collect in the bottom of the drum.

In Fig. 4 I have illustrated a slightly-modified form of the means for discharging the particles or values from the drums, and in this case the opening for the discharge of the particles is located to one side of the lower portion of the drum, preferably opposite the inlet for the air or fluid, as shown at n. In this modified form of structure it will be noticed that the currents of air or fluid as they enter the drum pass directly over the lower inner surface thereof and pass the opening n; but said opening being extended from the side of the drum inward, as shown, will permit the heavy particles or values as they seek to fall after being raised by the incoming air or fluid currents to pass directly into the concentrate-box.

While I have described the above specific form of device in detail as the preferred embodiment of my invention, it is to be understood, of course, that the parts may be varied within wide limit, and while I have shown each drum provided with a separate branch pipe leading to the inlet to the drum this specific arrangement is not essential, as any means for directing the current of air or fluid in a manner such as to provide for the decreased energy of the currents in the successive drums would be within the scope of my invention.

The operation of my device is as follows: The comminuted or ground material is fed to the series of drums in any preferred manner, as by the hopper H, and as it enters it is acted upon at once by the strong blast of air or fluid introduced in the small end drum A of the series. The whirling action thus given the material permits only the heaviest particles or values to fall against the circular currents and be discharged. The remaining particles and values, together with their impurities, continue to whirl in the drum A and eventually pass into the second drum B through the end opening a', where the material is at once acted upon by the decreased air or fluid currents, which continues its whirling and circular movement; but by virtue of its decreased force the particles and values which were too light to be permitted to fall against the currents in drum A are now permitted to settle to the bottom of the drum B, the remaining portion of the material being carried from the opening b' into the next larger drum of the series, where the action just described is repeated. The concentrates collect upon the wing h^3 of the door. The latter automatically dumps the same into the concentrate-box beneath, where they collect and are discharged from the discharge-chute. The light valueless particles and impurities mixed with the ground material continue over the same series of drums in their whirling and progressing movement until they reach the last drum of the series D, where they seek an exit from the series of drums through the exit-pipe P.

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

1. In an ore-concentrator, the combination of a plurality of stationary drums arranged in series and connected end to end, an inlet for introducing ores or the like into the first drum of said series of drums, and means tangential to the drums for introducing a separate or independent blast of air or other fluid into each of said drums to thereby cause the material contained in the drums to travel in circular paths within the same.

2. In an ore-concentrator, the combination of a plurality of drums arranged in series and connected end to end, an inlet for introducing ores or the like into the first of the series of drums and means for introducing a separate or independent blast of air or other fluid tangentially into each of said drums to cause the material therein to travel in circular paths within the drums.

3. In an ore-concentrator, the combination of a plurality of drums arranged in series and connected end to end, an inlet for introducing ores or the like into the first of the series of drums, means for introducing a separate or independent blast of air or other fluid tangentially into each of said drums throughout the length thereof and provisions for varying

the force of the blast in the different drums of the series.

4. In an ore-concentrator, the combination of a plurality of drums of different sizes arranged in series, the end of one drum being connected to the end of the next-larger drum of the series, an inlet for introducing ores or the like to the said series of drums, and means tangential to the drums for introducing separately into each drum an independent blast of air or other fluid to cause the material to circulate in curved paths within each of said drums at desired velocities.

5. In an ore-concentrator, the combination of a plurality of drums of varying size arranged in series and connected end to end, each of said drums being provided with a concentrate-box and an outlet for the concentrates leading to said box, an inlet for introducing ores or the like to the first drum of said series of drums, and means for producing gyratory currents of air or other fluid in said drums.

6. In an ore-concentrator, the combination of a plurality of drums arranged in series and connected end to end, a flange partially closing the opening leading from one drum to the next adjacent drum, means for introducing ores or the like into the end drum of the series and means for separately introducing a blast of air or other fluid into the different drums of the series.

7. In an ore-concentrator, the combination of a plurality of drums arranged in series and connected end to end, said drums varying in size from end to end of the series, means for feeding ores into the first of the series of drums, means tangential to the drums for introducing a blast of air or other fluid into each of said drums and devices for regulating the force of the blast in each drum.

8. In an ore-concentrator, the combination of a plurality of drums arranged in series and connected end to end, said drums progressively varying in size from end to end of the series, means for feeding ores or the like into the end drum of the series, an air or fluid inlet to each of said drums, said inlets varying in size inversely as the size of the drum and a discharge-outlet for said drums.

9. In an ore-concentrator, the combination of a plurality of drums arranged in series and having open end connections, a separate air or fluid inlet for each of said drums extending substantially the length thereof and tangential thereto, means for feeding ores to the first of said drums, and a discharge-opening for the concentrates in each of said drums.

10. In an ore-concentrator, the combination of a plurality of drums arranged in series and having open end connection, a flange partially closing the opening leading from one drum to the next adjacent drum, a discharge-opening for the concentrates in each of said drums, and means substantially tangential to the drums for introducing a blast of air or other fluid into each of said drums across the said discharge-opening therein.

11. In an ore-concentrator, the combination of a plurality of drums arranged in series and having open end connections, said drums varying progressively in size from end to end of the series, means for introducing ores or like material to the first drum of the series, a discharge-opening for the concentrates in each drum, an axial exit for the light impurities separated from the valuable particles, and means for introducing tangential air or fluid currents into each of said drums.

12. In an ore-concentrator, the combination of a drum, a discharge-opening formed in the wall of said drum, a normally closed door for covering said opening and on which the values or concentrates may rest, said door being counterbalanced to automatically discharge the concentrates that collect thereon, an air or fluid inlet extending lengthwise of the drum and arranged tangential thereto to direct a blast directly upon and over said door to thereby subject the concentrates or values to a strong fluid current prior to their being discharged.

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