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 APPARATUS FOR GRADING PULVERULENT MATERIALS.
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Fig: 1.

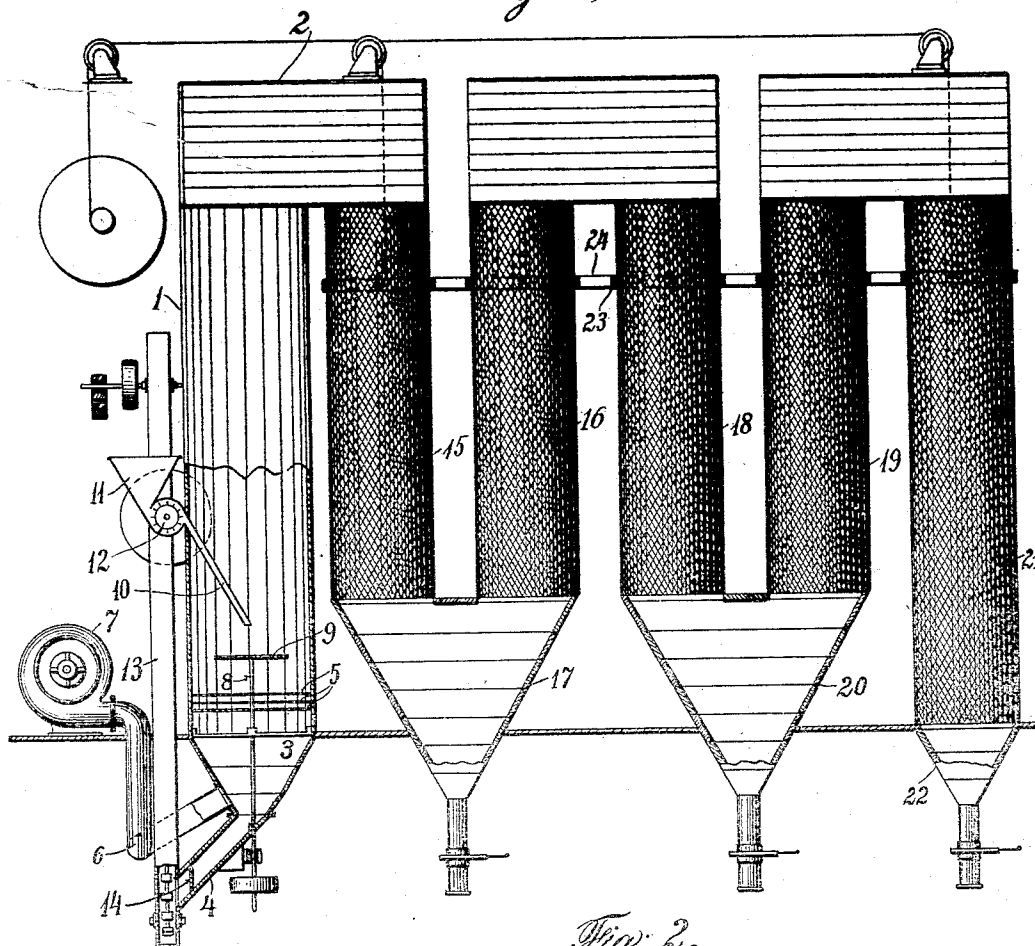


Fig: 2.

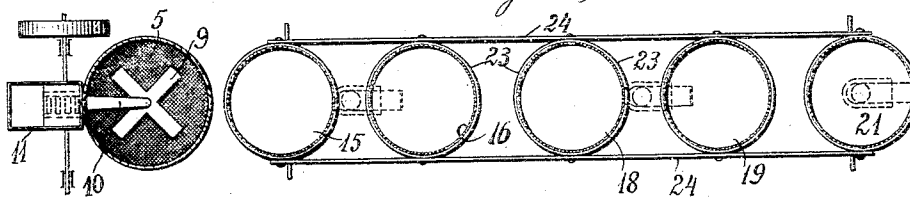
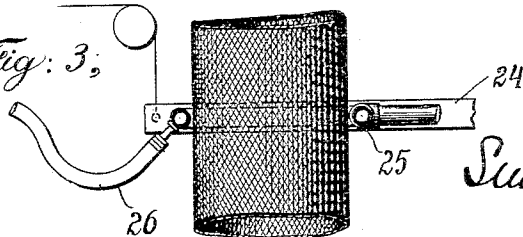


Fig: 3.



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APPARATUS FOR GRADING PULVERULENT MATERIALS.

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To all whom it may concern:

Be it known that I, SIMON COOPER, a citizen of the United States, residing in the borough of Manhattan, city, county, and State of New York, have invented certain new and useful Improvements in Apparatus for Grading Pulverulent Material, of which the following is a full, true, and concise specification, from which others skilled in the art will be able to make, construct, and use the same.

The invention seeks to separate or assort pulverulent material into different grades of fineness, by means of an ascending air column which is made to act upon the material in opposition to the force of gravity thereon and to select and carry out of the mass of the material such particles thereof as are sustainable upon the air current, and after such selection, to carry the same forward for deposit in any desired manner, or for further classification, for which purpose the current proceeds with a diminishing velocity whereby on becoming gradually and successively unsustainable on the current, according to their weight, the said particles fall into or are deposited in suitable receptacles successively arranged for that purpose. In this manner it is sought to grade and classify finely divided or impalpable material continuously and with precision, separating it into any desired number of true grades of fineness, that is to say, into grades whereof the particles do not exceed in size a predetermined value and are substantially uniform.

The invention involves the disposition and relative arrangement of apparatus for accomplishing the above results and certain features of construction and operation therein, as hereinafter explained and more particularly pointed out in the accompanying claims.

In the drawings forming a part hereof, Figure 1 is a vertical side elevation of a form of my apparatus, with parts broken away and shown in section; Fig. 2 is a transverse sectional view through the several trunks of the apparatus; and Fig. 3 is a modified detail.

The apparatus comprises, in combination, an upright imperforate trunk 1, designated herein the main separating or classifying trunk, which may be made of wooden boards,

as indicated, or of any suitable air-tight construction, and of any desired cross-sectional shape, provided it is adapted for a certain portion of its length to conduct an upward column of air with uniform and constant velocity, as hereinafter explained. It is preferred that this trunk shall be of uniform cross-sectional shape and size. It has a lateral outlet connection 2 at the top and air-admission means at its bottom. The air-admission means comprises a chamber 3, which as a matter of convenience is formed within and by the base-portion of the cylindrical wall of the trunk, with its floor formed as a hopper which leads to an inclined discharge spout 4. The air-chamber 3 is separated from the interior of the trunk proper by means of one or more transverse diaphragms 5, of perforated or foraminous construction adapted to admit air from the chamber to the trunk, as later explained. Such air is supplied to the chamber through an air-pipe 6 leading from a blower 7 or other suitable source of air pressure, and the cubical capacity of the chamber is relatively large as compared with the delivery of the blower so that the chamber will serve as an air reservoir or collector of sufficient volume to absorb or neutralize slight variations in the blower, or the pulsations caused by its revolving fan-blades and so that the pressure of the air below the diaphragms shall be substantially or generally the same at all points in order to promote an even and uniform upward passage of air through the latter. In the practical operation of the apparatus this consideration is important. For increasing the capacity of the chamber, its dimensions may be extended farther than the boundaries of the trunk, or it may be connected with other air receptacles adapted for the storage of air. The air thus passing upwardly through the foraminous diaphragms is divided into a number of more or less equal jets, and such differences of pressure as may have previously existed beneath the diaphragms, if not equalized and diffused after passing the first of the diaphragms becomes so in any event in the region immediately above them, so that an ascending column of air is sooner or later produced which has a substantially uniform tension and velocity at all points of its cross-section and moves upwardly with a constant

motion. The total of the openings in at least one, preferably the upper, of the diaphragms should preferably not exceed more than twenty per cent. of its total exposed area, and the said openings should be of uniform size and uniformly distributed so that finely divided and uniform jets will be produced at all points. The other diaphragms may be somewhat coarser. The preferred and most serviceable size of the openings or percentage of total openings for the finest of the diaphragms will depend somewhat on the nature, the weight and size of the material under treatment, being preferably finer or a lower percentage of opening for less weight or size, and vice versa, coarse burlap being suitable for many materials. The region of pressure equalization or adjustment which exists immediately above the diaphragms extends upwardly more or less, depending upon the pressure of the air in the air-collecting chamber and the fineness and number of the diaphragms, and gradually merges into and forms the air column above referred to, of uniform and constant velocity, ascending within the trunk and passing out through the upper outlet. The material to be graded is fed into the air current and distributed, preferably in the line of the longitudinal axis of the trunk, at a point above the diaphragms, and in or above the afore-said region of pressure adjustment where the multiplicity of fine jets from the upper diaphragm are becoming merged into the column of constant velocity.

The invention includes and prefers a distributor apparatus which consists of an upright shaft 8, power-driven and appropriately journaled as indicated in the longitudinal axis of the trunk and carrying a number of fine beater-blades 9 designed to produce as slight air disturbance in the trunk as possible. These blades revolve directly beneath the delivery of the feed-chute or spout 10, which leads from the feed hopper 11 through a suitable rotary feeding device 12, consisting, for example, of a usual conveyer wheel revolving within a casing and adapted to prevent back flow of air and powdered material through the spout. This feeding device is driven by suitable gearing, not specifically shown, and is susceptible of regulation so as to feed in material as required. The conveyer 13, of ordinary construction may supply the feed-hopper 11 with tailings from the tailings spout 4 or any other source, the said conveyer, like the feeding wheel, being intended to be driven in any convenient manner and to be also susceptible of regulation. The material fed and distributed by the beater 9 as above described, is encountered by the upward air current and those particles which by reason of their size or weight or both, are not sustainable on the particular pretermind ve-

locity of current, fall more or less promptly upon and through the fine apertures in the diaphragms and into the air-collecting chamber 3, from which they may pass out as tailings through the spout 4, which latter is provided with flap valve 14 or some equivalent arrangement to prevent also the escape of air. Some of the finer particles may adhere to the tailings and also pass into the hopper, on which account the deposit in the latter may be returned through the main trunk one or more times, as required for thorough separation. The remaining and finer particles, being those which are for the most part sustainable, on the particular current velocity in the trunk and which succeed in reaching the point where the air column takes on its uniform and constant velocity, are carried upwardly thereby toward the upper outlet of the trunk, but those which are not indefinitely sustainable on the said current will fall back with the tailings before the outlet is reached so that only a certain definite maximum grade size can pass out from the upper outlet, as predetermined by the velocity of the constant air column, it being characteristic of this invention that the classifying trunk is so proportioned that the said column is of sufficient length and velocity as to allow all such undesirable particles to fall back of their own weight before the outlet is reached. After this selection has been fully accomplished, it is only essential that the velocity of the current shall not thereafter be diminished until the outlet has been passed. The proportions of the trunk, and particularly the length thereof, may be varied, according to the kind or quality of the material to be treated, and will have generally and desirably a greater length for materials of lighter specific gravity or in which the tailings and the air-selected particles are very closely related in size and considerable length will ordinarily be the most satisfactory. The proportions of trunk illustrated in the drawings are such as are suitable for material like ordinary talc powder or ground quartz. The velocity of the air column may be regulated to control the maximum grade size which it is desired shall pass out of the upper outlet for further classification and assortment, the said velocity being the primary controlling factor of the classifying or separating process.

The column of air with its burden of selected particles, on leaving the upper outlet 2, enters a filtering conduit wherein its velocity is gradually diminished by the continuing filtration of air through the textile material of which the walls of the said conduit are formed. This filtering conduit is arranged in a series of pairs of upright filtering trunks successively connected at top and bottom and supplied with hoppers at their bottom connections. In the first pair,

designated 15 and 16, the air current passes downwardly and then upwardly and on reaching the entrance to the second pair, has a velocity so diminished by the filtration that the maximum size particles which it is capable of sustaining and carrying over to the next pair of filtering trunks is a somewhat finer grade size than the maximum size that passed through the outlet 2. The particles falling out or filtered from the air during the passage through the first pair of trunks constitute the first and largest grade size and fall or are collected in the hopper 17 disposed at the bottom of the trunks for that purpose and from which withdrawal may be made as indicated. In the next pair of filtering trunks, 18 and 19, a similar selection is repeated, a still smaller maximum size of particles being sustainable at the outlet of the trunk 19 and of each of the following upward filtering trunks, and so on, so that successively finer grades are collected in the hopper 20 and in the successive hoppers, until the motion of the original air current has been practically dissipated in a final trunk 21, where the finest of the grades is deposited in its hopper 22. The particles filtered out of the air which escapes through the textile filtering walls in the several trunks and which may cling to the fabric, are dislodged by means of a series of cleaners and fall into the hoppers. These cleaners are shown in Figs. 1 and 2, as consisting of hoops or rings 23 embracing each of the filtering trunks and assembled in a supporting frame 24 and mechanically guided and reciprocated in light rubbing contact with the outside of the textile walls of the trunks. The drawing illustrates a harness of cords and sheaves operated from a windlass by which the frame and cleaner rings can be raised and lowered either by hand or power, but any suitable method may be employed for this purpose. The cleaner ring or member 23 is formed of sufficient width or dimension in the direction of its movement, to trap a film of air between it and the textile wall upon or over which it moves, and by the compression of the said air film, the ring sets up the counter pressure acting against and through the fabric, which effects the dislodgment. A preferred form of cleaner apparatus consists of a pipe section 25, circular or otherwise, mounted on the reciprocating frame 24, instead of the hoops 23, and in communication, as by pipe 26, with a source of air pressure so as to direct a blast or a series of jets of air against the exterior of the walls, as the frame moves up and down, thereby dislodging the material adhering to the inner side of the walls by means of counter-pressure, but without physical contact or wear thereupon.

The relation of the several grade sizes produced by the above-described apparatus will

depend upon the adjustment of the main classifying or separating apparatus, the length and height of the several filtering trunks, the material of which they are made, and, of course, the nature of the material under treatment, as will be plain to those skilled in this art. In form, the filtering trunks may be cylinders or otherwise as may be preferred, and their arrangement may conform to the locality in which erected.

The invention is specially useful for the assortment and grading of very fine materials, less than 200 mesh, and, by virtue of the constant movement and uniform velocity of the air column and the mode of introduction of the material, as above described, enables such materials to be separated into a series of distinct grades of fineness having greater uniformity of size than has hitherto been possible with air-flotation apparatus.

I claim as my invention the following:—

1. In apparatus for grading pulverulent materials, an upright trunk having air-admission means at its base, comprising one or more air-diffusing and pressure-equalizing diaphragms, and an outlet for dust-laden air at its top, and being closed against the entrance or escape of air between said diaphragm and air-outlet, and being further of uniform cross-sectional area and of sufficient length between said diaphragm and outlet to enable a classifying current of air admitted, and rising therein, to assume a constant and uniform velocity within the trunk, in combination with means for feeding the material to be graded into the air current, above the said diaphragm, an air-filtering conduit connected with the outlet at the top of said trunk for gradually diminishing the velocity of said air current and comprising a series of classifying trunks formed with air-filtering walls and successively connected in tandem relation with each other and with said upper outlet, and receptacles at the ends of said trunks adapted to receive successively smaller grades of the classified material.

2. In apparatus for grading pulverulent material, an upright trunk having an air inlet and tailings receptacle at its bottom and an outlet for dust-laden air at its top, and being closed against the entrance or escape of air between said air inlet and outlet, and being, further, of uniform cross-sectional area and of sufficient length between said inlet and outlet to enable a classifying current of air introduced and rising therein to assume a constant and uniform velocity within the trunk, in combination with a feeding means comprising a chute closed against the passage of an air current and mounted to conduct the material to be graded into the interior of said trunk at or above the place therein where the air current becomes constant and uniform, a posi-

tively driven distributor within said trunk and at the mouth of said chute and adapted to act on the material delivered thereby.

3. In apparatus for grading pulverulent materials, an upright imperforate separating trunk having a tailings hopper and air inlet at its bottom and an upper outlet for dust-laden air and being closed against entrance or escape of air between said inlet and outlet and being of uniform cross-sectional area between said inlet and outlet, in combination with means for producing an ascending current of constant and uniform velocity through said trunk, comprising a blower pipe, an air chamber in the base of the trunk of relatively large cubical capacity with reference to said pipe, and a foraminous air-diffusing and pressure-equalizing diaphragm, dividing said chamber from the trunk and transmitting the air therefrom upwardly into the trunk, and means, closed against the passage of air currents, for introducing the material to be graded into the path of said upwardly ascending air.

4. In apparatus for grading pulverulent materials, an upright imperforate separating trunk having a tailings hopper chamber in its base and an upper outlet for dust-laden air, and being closed against entrance or escape of air between said hopper chamber and upper outlet and being of uniform cross-sectional area between said hopper chamber and outlet, means for producing an ascending current of uniform and constant velocity upwardly within said trunk, comprising an air inlet pipe leading from a suitable fan or blower to the hopper chamber, the latter being of relatively greater diameter than said air inlet pipe, and one or more foraminous air-diffusing and pressure-equalizing diaphragms dividing said trunk from the said hopper chamber and admitting air from said chamber upwardly into and through said trunk, in combination with a filtering conduit connected with the said upper outlet.

5. In an apparatus for grading pulverulent materials, an upright imperforate separating trunk having an outlet for dust-laden air at its top and a tailings hopper at its base, and two or more foraminous diaphragms superposed one above the other and separating said hopper and trunk, said trunk being of uniform cross-sectional area and also closed against the entrance or escape of air between said upper outlet and the said superposed diaphragms and being of sufficient length between said outlet and diaphragms to enable the air rising through the latter to assume a constant and uniform velocity within said trunk, in combination with means for feeding the material to be graded into said trunk above the said superposed diaphragms.

6. In apparatus for grading pulverulent

materials, an upright separating trunk, having air admission means at its base and an outlet for dust laden air at its top, and being closed against the entrance or escape of air between said air admission means and outlet, and being further of uniform cross-sectional area between said parts and of sufficient length between said parts to enable a classifying current of air entering therein to assume constant and uniform velocity within the trunk, the said air admission means comprising one or more air-diffusing and pressure-equalizing foraminous diaphragms through which the air issues upwardly into said trunk, in combination with means closed against the entrance or escape of air for feeding the material to be graded into said trunk and a filtering conduit connected with said upper outlet, comprised of a plurality of upright classifying trunks formed with textile filtering walls alternately connected by their tops and bases in tandem relation, and grade receptacles at the junctions of the bases of said trunks.

7. In an apparatus for grading pulverulent materials, a separating trunk having an outlet for dust-laden air at the top and one or more air diffusing and pressure equalizing diaphragms at its base forming a partition between the main part of said trunk and an air inlet chamber, the said trunk above the said chamber and below the upper air outlet being closed against the entrance or escape of air, and the said diaphragm having not more than 20% of its total exposed area constituted of uniformly distributed openings, through which the air passes from said chamber upwardly into the said trunk, in combination with means for feeding the material to be graded into the main part of said trunk above the said diaphragm therein.

8. In apparatus for grading pulverulent material, an upright separating trunk having an air outlet at its top and an air inlet at its bottom and being of uniform cross-sectional area and also closed against the entrance or escape of air between said inlet and outlet, one or more air-diffusing and pressure-equalizing diaphragms disposed across said trunk and dividing the lower part thereof into an air chamber, in combination with a feed chute closed against the passage of air and leading from the exterior of said trunk to approximately the central axis thereof and a power-driven distributor revoluble beneath the delivery of said chute.

9. In apparatus for grading pulverulent material, an upright separating trunk having an air outlet at its top and air inlet at its bottom and being of uniform cross-sectional area and closed against escape or entrance of air between said inlet and outlet, one or more air-diffusing and pressure-equalizing diaphragms disposed across said trunk, dividing the lower part thereof into

an air chamber, and having 20% or less of their total exposed area constituted of air openings, and means for feeding the material to be graded into said trunk above said
5 diaphragm or diaphragms, in combination with an air filtering conduit comprising a series of upright filtering trunks having textile walls and connected in tandem relation with said upper outlet of the trunk and
10 means for the reception of the different grades at the bases of said upright filtering trunks.

10. In apparatus for grading pulverulent material, the combination with an air-filtering trunk, formed with textile walls, of

a cleansing device, for said walls comprising a movable, tubular member, embracing the exterior of said trunk, and provided with one or more orifices directed toward said trunk, means for supplying compressed air
20 to said member, and means for reciprocating the same over, but not in contact with the surface of said walls.

In testimony whereof, I have signed my name to the specification in the presence of
25 two subscribing witnesses.

SIMON COOPER.

Witnesses:

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