R. E. TROTTIER.

APPARATUS FOR THE CLASSIFYING AND SEPARATION OF SOLID BODIES BY COMBINED ACTION OF ORIENTATION, DEVIATION, AND DERIVATION.

APPLICATION FILED NOV. 21, 1917.

1,400,390. Patented Dec. 13, 1921.

2 SHEETS—SHEET 1.

Fig. 4

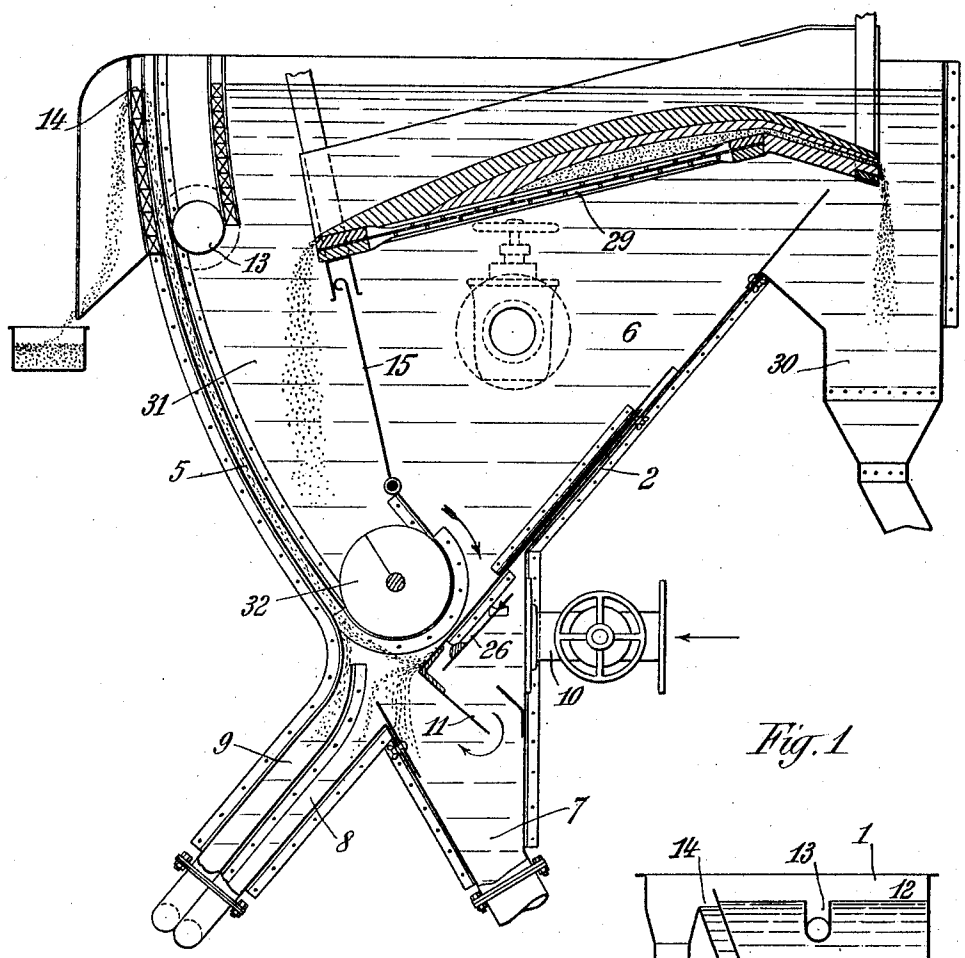
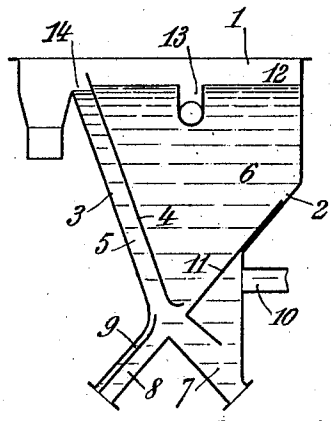


Fig. 1



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2 SHEETS—SHEET 2.

Fig. 2

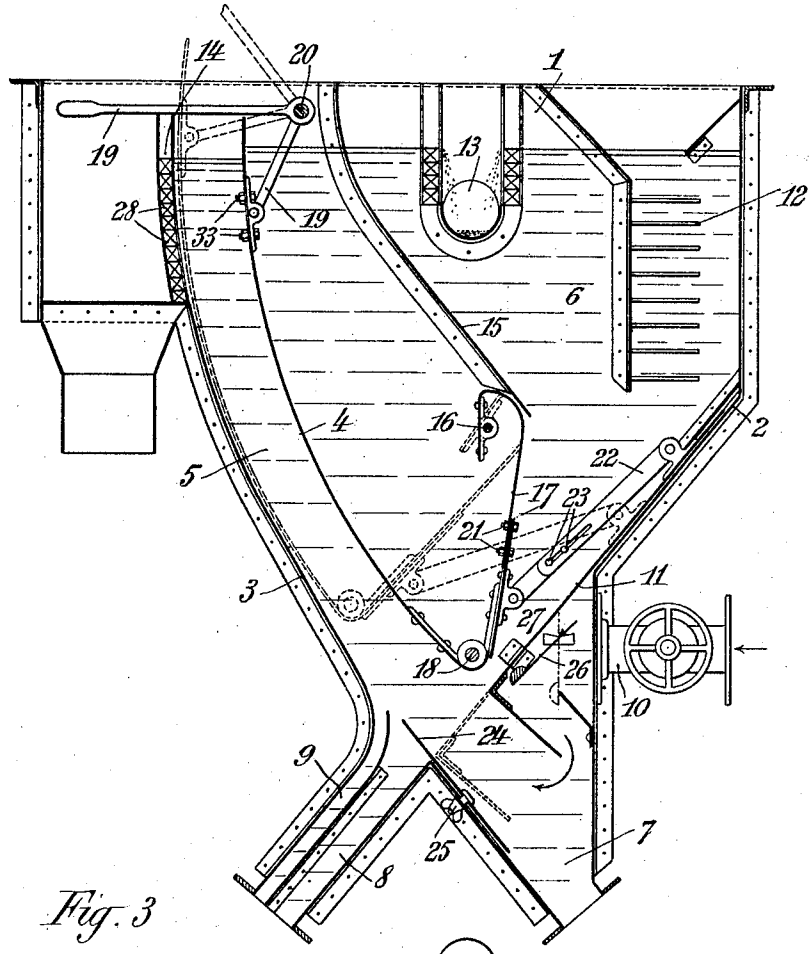
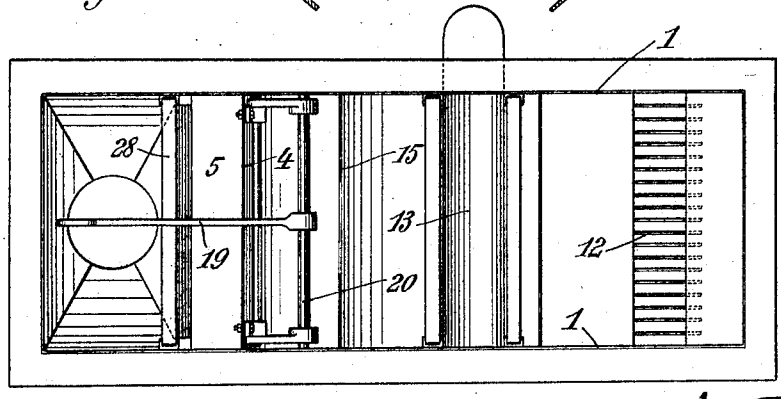


Fig. 3



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UNITED STATES PATENT OFFICE.

RENÉ EMILE TROTTIER, OF PUTEAUX, FRANCE.

APPARATUS FOR THE CLASSIFYING AND SEPARATION OF SOLID BODIES BY COMBINED ACTION OF ORIENTATION, DEVIATION, AND DERIVATION.

1,400,390. Specification of Letters Patent. Patented Dec. 13, 1921.

Application filed November 21, 1917. Serial No. 203,278.

(GRANTED UNDER THE PROVISIONS OF THE ACT OF MARCH 3, 1921, 41 STAT. L., 1313.)

To all whom it may concern:

Be it known that I, RENÉ EMILE TROTTIER, a citizen of the Republic of France, and a resident of 84 Rue de la République, Puteaux, Seine, in the Republic of France, have invented a new and useful Apparatus for the Classifying and Separation of Solid Bodies by Combined Action of Orientation, Deviation, and Derivation, (for which I have filed application in France Feb. 29, 1916,) of which the following is a specification.

This invention consists in an improved apparatus for the classifying and separation of solid bodies, according to which the particles to be separated are first classified simultaneously by equivalence and according to their shape, then submitted to the action of appropriate separating currents, determining successively the deviation and the regression or derivation of the particles according to their equivalence and their shape.

This improved apparatus, utilizing simultaneously the difference of the form of the grains and their equivalence, permits the separation of substances of the same density and the same equivalence, but of different nature and form, and consequently a classification giving results superior to those obtained by apparatus hitherto used and dealing with the same substances, being effected.

To render the following description clear, it may be here stated that two bodies are termed "equivalent" when they sink in water at the same rate. By the term "deviation" is meant the action produced in a body falling in a fluid and resisting medium by an incidental force whose direction makes any angle with the vertical, the vertical component of this force being insufficient to reverse the direction of movement of the falling body and, consequently, smaller than that necessary to counterbalance the weight of the body, deduction being made for the volume of water displaced. Finally, by the term "derivation" is meant the action produced under the above indicated conditions by an incidental force in a direction opposed to the vertical or making with the latter an angle less than 90°, the vertical component of this force being sufficient to reverse the direction of movement of the falling body, and consequently always greater than that necessary to balance the weight of the body, deduction being made for the volume of water displaced.

If there is thrown into a vessel, filled with still water, two grains of equal volume and density but of very different form, for example, one spherical and the other flat, the spherical grain falls vertically in a straight line, while the flat grain follows a crooked line, or in other words tacks about or oscillates, and it does not reach the bottom of the vessel till after the spherical grain. On repeating this experiment after putting the water in motion from bottom to top, it will be found that the spherical grain, on the contrary, will reach the bottom of the vessel after the flat grain if the plane of the greatest or effective section of the latter is substantially vertical. This is because the action of the current on the spherical grain is maintained constant, by reason of the effective section of such a grain remaining invariable; while the flat grain is immediately orientated or turned by the current in a manner to present to the current the section of least resistance. The flat grain falls more slowly the nearer the position of its plane of greatest section approaches the horizontal plane.

Thus, the speeds of descent of bodies in a fluid and resisting medium decrease as the ratio of their extreme dimensions, if the medium in which the fall occurs is at rest, and increase as this ratio and as the rate of flow of the medium when the medium is in movement and as the plane of the largest section of the body approaches the vertical. By interposing devices appropriate for deviation and derivation while these phenomena are produced, it should be possible to obtain an effective separation of the bodies according to their forms and quite independently of their density. Such is the basis of the present invention.

Figure 1 of the accompanying drawings is a diagrammatic view of the apparatus in its simplest form.

Figs. 2 and 3 are a vertical section and a plan showing the preferred construction of the apparatus.

Fig. 4 is a vertical section showing the

feeding of the apparatus by means of an oscillating separating device of the kind described in the United States Patent No. 1074301, dated September 30th 1913.

In the several figures corresponding parts are denoted by similar numerals.

The apparatus in Fig. 1 is composed of a vessel having two parallel vertical walls 1, a third wall 2 that is inclined and a fourth wall 3, which preferably is also slightly inclined or curved. At a suitable distance from this latter is arranged a partition 4 in a manner to form a passage 5. On the inclined wall 2 is placed a plate 11 with a bent end, which extends to about the level of the lower end of the passage 5. At about that level commence two diverging emptying channels 7 and 8, and adjoining the latter is another channel 9. Opposite plate 11, a duct 10 opens into the side wall of the vessel and conducts against the lower face of the plate 11 water under pressure in a manner to set up an ascending current of water in passage 5, while a slight descending current is set up in the vessel by means of an adduction of water. The feeding in of the material to be classified is effected by means of a suitable distributer arranged at 12 above the level of the water and over the inclined wall 2. The compartment 6 is provided with an overflow 13 and the passage 5 is also furnished with an overflow weir 14.

If, in apparatus thus arranged, substances which it is desired to separate be fed in at 12, after water is allowed to enter at 10, the following will occur:—

In descending in the comparatively motionless water in compartment 6, the substances will become classified according to their equivalence and slide over the inclined portion of wall 2 and the plate 11; the round grains advance in front of the flat grains since the latter fall slower and are, moreover, retarded by rubbing on plate 11. On arrival at the bottom of plate 11 the lightest grains, incapable of traversing the current of water issuing from the side duct 10, are immediately carried by the current into the passage 5 up to the level of the overflow, 4, while the heavier grains, capable of traversing the current fall toward the orifice of the outlet 7. The round grains, too light to reach outlet 7 but too heavy to reach overflow 14, rise part way up the passage 5, then fall, sliding along wall 3 of the vessel and finally arrive at outlet 9, or they are thrown directly into 8 by deviation.

As to the flat grains, which slide in rear of the round grains on the inclined surfaces 2, 11, lying on their large face, they are presented flatwise to the ascending current, that is to say under conditions most unfavorable for traversing it and, retained in this position by the descending current in the vessel, they are diverted toward the passage 5; the combined effect of the two currents is such as to turn them so that they present their smallest section to the flow of the water, and, consequently, fall, sliding along the outer wall 3 where the ascending current is slower than on the opposing wall 4, and finally arrive at outlet 9 where they are evacuated.

Thus, the treated substances, be they very fine, granular or in fragments, are classified in four categories according to their form and density, viz:—

At outlet 7, heavy products or of high density (non deviated);

At outlet 8, products of medium density, or mixed (deviated);

At outlet 9, flat products, of any density (orientated);

At overflow 14, light products, or of low equivalence (derived).

Moreover, if the substances are sedimentary, the fine particles in suspension are evacuated by the overflow 13 in the compartment 6 of the vessel.

It goes without saying that when there is no disadvantage in mixing several kinds of products, the outlet ducts 8 and 9 can be combined in one or both can be omitted.

The apparatus above described is free from the faults found in the Spitz-Kasten apparatus generally used for classifying by equivalence substances too fine for their volumetric classification to be possible.

In the improved system of classified separation as it will be seen the particles, after submission to a classification by equivalence in still water, are subjected to a second classification, according to their form, in moving water, without any particle being able to remain is suspension at any moment.

A more practical form of the apparatus for effecting the object of the invention is constructed, as shown in Figs. 2 and 3, in a manner to allow of its adjustment for obtaining the best results for a given substance and to adapt the apparatus to the classification of different substances.

In the apparatus shown in Fig. 2 an auxiliary partition 15 is added, and below it is a spindle 16 about which is adapted to turn a plate 17 connected by a hinge 18 to plate 4 to which is given the same curvature as the fixed wall 3 of the vessel; at the upper part of this plate 4 is articulated a bell crank lever 19 whose axis of rotation 20 is carried by the fixed walls of the vessel. By operating this lever the plate 4 can be brought nearer (as indicated in dotted lines in Fig. 2) or retracted farther from the wall of the vessel in order to increase or diminish at will the section of passage 5. This plate 17 coupled by the bolts 21, as also lever 19 coupled by bolts 33, slide in openings arranged in plate 4. This arrangement is for regulating the passage way between piece 18 and piece 24, and consequently the speed

of the current descending in the vessel, without interfering with the parallelism of walls 4 and 5 for the ascending current.

On plate 17 is articulated one end of a connecting rod 22, adjustable by means of the members 23, the other end of rod 22 being attached to the flanged plate 11; plate 11 is displaced at the same time as the movable partition 4 and the position of its bent end is automatically adjusted by the same regulation as that for the section of passage 5.

Finally, a register 24 sliding on the wall of the outlet passage 7 and furnished with clamping screws 25 permits the size of the entrance orifice of this passage, and the amplitude of the deviation, being regulated.

A weighted shutter 26, movable on the knife edges 27 can under the action of the current of water entering at 10 turn aside in a manner to distribute it and to regulate it.

The height of the overflow weir 14, at the upper part of the curved partition 3, is adjusted by means of the removable wooden frames 28 held between guides. The same arrangement is applied to the overflow gutter 13.

For feeding the apparatus shown, Figs. 2 and 3, a vertical distributer with prongs 12 arranged in the main compartment of the vessel is employed. For preference, the diluted substance is thrown intermittently on to the distributer so that the flat grains are not submitted at the same time as the round grains to the action of the currents at the lower part of the inclined plate 11; this, however, is not indispensable.

In Fig. 4 is an apparatus in which the distributer 12 is replaced by an oscillating device 29 of the kind described in the above cited patent which is adapted to cause a classification by volume and density, without the influence of equivalence, before the classification by equivalence which will be effected by derivation, which permits a complete washing operation giving the desired concentration and separation. It goes without saying that for each substance which it may be desired to classify there should be employed a series of these combined apparatus, with differently perforated screens constituting the oscillatory devices.

Grains larger than the screen perforation and of high equivalence going out at the head of the oscillating screen 29, fall into the conduit 30 situated in front of the vessel, to be treated in an oscillator having a screen with larger perforations. The lighter grains of small equivalence, going out at the lower end, fall into 31 in the middle compartment of the vessel and are constantly evacuated, for instance by means of an Archimedean screw 32. All the grains passing through the meshes of the screen will be subjected to the action of the derivation currents in the manner described above.

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

1. Apparatus of the character described comprising, a vessel, means for supplying a classifying medium to the upper part thereof, means for depositing in the medium material to be classified, a downwardly extending surface adapted to interrupt the downward movement of the material, a partition arranged adjacent the side of the vessel opposite said surface for forming a channel between said partition and said side of the vessel, a downwardly extending outlet from said vessel, a downwardly extending outlet from said channel, an outlet at the top of said channel, and means for supplying a classifying medium to the lower portion of the vessel to ascend in said channel, whereby the material is classified and different parts thereof ejected from said various outlets.

2. Apparatus of the character described comprising, a vessel, means for supplying a classifying medium to the upper part thereof, means for intermittently depositing in the medium materials of different form to be classified, a downwardly extending surface adapted to interrupt the downward movement of the material, a partition arranged adjacent the side of the vessel opposite said surface for forming a channel between said partition and said side of the vessel, a downwardly extending outlet from said vessel, a downwardly extending outlet from said channel, an outlet at the top of said channel, and means for supplying a classifying medium to the lower portion of the vessel to ascend in said channel, whereby the material is classified and different parts thereof ejected from said various outlets.

3. Apparatus of the character described comprising, a vessel, means for supplying a classifying medium to the upper part thereof, means for depositing in the medium material to be classified, a downwardly extending surface adapted to interrupt the downward movement of the material, an auxiliary partition located in the vessel and fitted to direct the material toward said surface, a main partition arranged adjacent the side of the vessel opposite said surface for forming a channel between said partition and said side of the vessel, a downwardly extending outlet from said vessel, a downwardly extending outlet from said channel, an outlet at the top of said channel, means for supplying a classifying medium to the lower portion of the vessel to ascend in said channel, and means for varying the distance between said surface and said auxiliary parti-

tion and between said main partition and the adjacent side of said vessel, whereby the material is classified and different parts thereof ejected from said various outlets.

4. Apparatus of the character described comprising, a vessel, means for supplying a classifying medium to the upper part thereof, means for depositing in the medium material to be classified, a downwardly extending surface adapted to interrupt the downward movement of the material, an auxiliary partition located in the vessel and fitted to direct the material toward said surface, a main partition arranged adjacent the side of the vessel opposite said surface for forming a channel between said partition and said side of the vessel, a downwardly extending outlet from said vessel, a downwardly extending outlet from said channel, an outlet at the top of said channel, means for supplying a classifying medium to the lower portion of the vessel to ascend in said channel, and means for varying the distance between said surface and said auxiliary partition and between said main partition and the adjacent side of said vessel and for varying the size of the downwardly extending outlet from the vessel, whereby the material is classified and different parts thereof ejected from said various outlets.

5. Apparatus of the character described comprising, a vessel, means for supplying a classifying medium to the upper part thereof, means for depositing in the medium material to be classified, means for supplying a classifying medium to the lower portion of the vessel, outlets at the bottom and top of the vessel, a main partition in said vessel, an auxiliary partition in said vessel, said auxiliary partition being connected to said main partition, a downwardly extending surface in said vessel, and a slide located in an outlet in the bottom of the vessel, both said partitions, said surface and said slide being adjustable for affecting the conditions of treatment of the material whereby the same may be properly classified.

In testimony, that I claim the foregoing as my invention, I have signed my name in presence of two witnesses, this seventh day of February, 1917.

RENÉ EMILE TROTTIER.

Witnesses:
CHARLES ASSI,
CHAS. P. PRESSLY.