

No. 888,767.

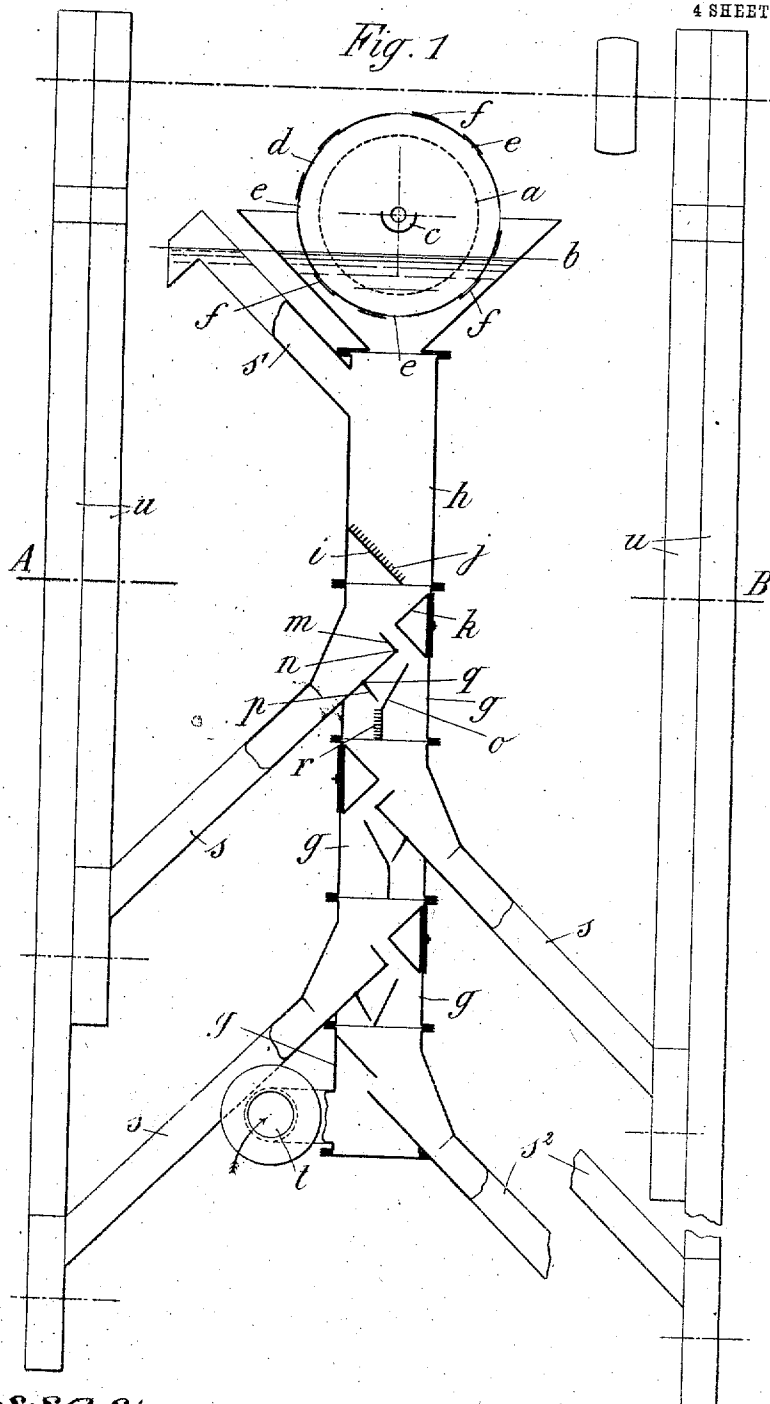
PATENTED MAY 26, 1908.

R. E. TROTTER.

APPARATUS FOR CLASSIFYING SOLID MATERIALS.

APPLICATION FILED APR. 18, 1907.

4 SHEETS—SHEET 1.



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4 SHEETS—SHEET 2.

Fig. 2

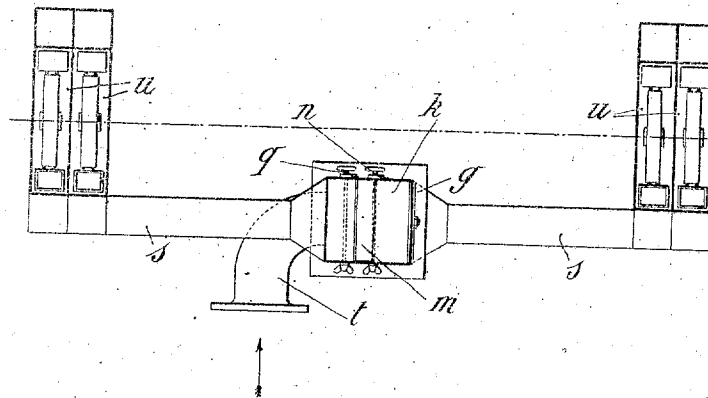


Fig. 3

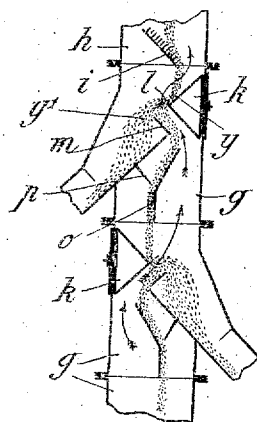


Fig. 4

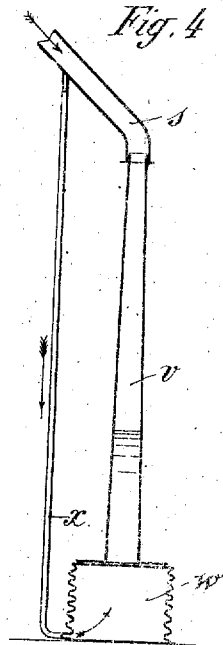


Fig. 5

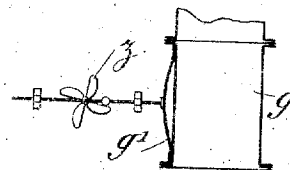
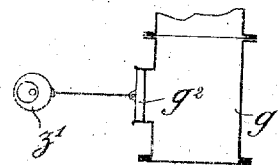


Fig. 6



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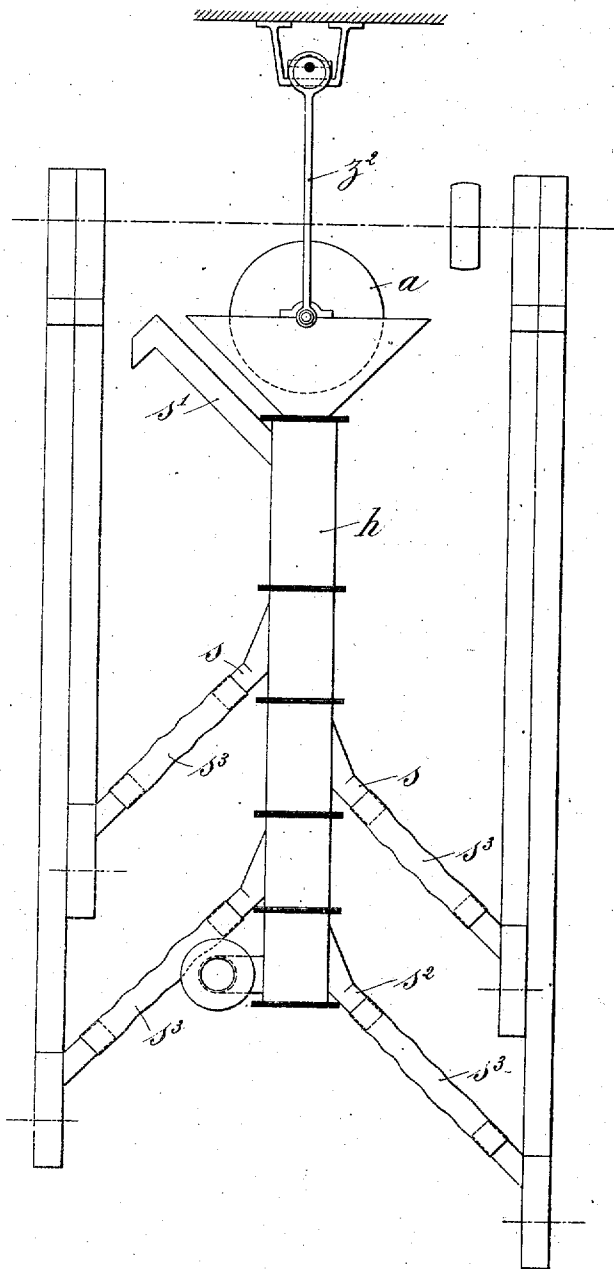
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4 SHEETS—SHEET 3.

Fig. 7



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4 SHEETS—SHEET 4.

Fig. 8

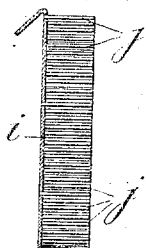


Fig. 9

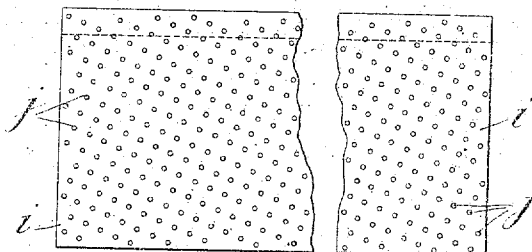


Fig. 10

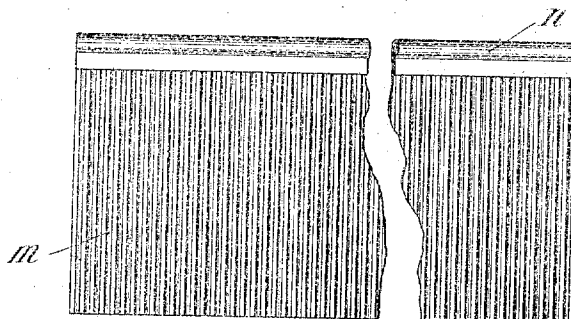
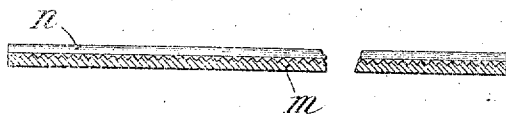


Fig. 11



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR CLASSIFYING SOLID MATERIALS.

No. 888,767.

Specification of Letters Patent.

Patented May 26, 1908.

Application filed April 18, 1907. Serial No. 368,993.

To all whom it may concern:

Be it known that I, RENÉ EMILE TROTTIER, citizen of the Republic of France, and resident of Hussein-Dey, Algeria, engineer, have invented new and useful Improvements in Apparatus for Classifying Solid Materials, of which the following is a specification.

This invention relates to improvements in apparatus for classifying solid matters by equivalence and by specific gravity in water or air in movement, by utilizing the velocity acquired by the bodies in falling and by deflecting them laterally by means of the classifying current, but without carrying the separated bodies along by said current.

In order to explain what is here connoted by the word equivalence, it may be said that two bodies are equivalent when notwithstanding that they are of different specific gravity, their linear dimensions and their resistance to the medium in which they descend are such that both bodies arrive at the same moment at a given point of their descent; in other words, the bodies are equivalent when the resistance of the medium to the descent of one compensates for the difference between the specific gravity of this one and that of the other. Thus two bodies descending in the same medium may be equivalent if they present to the action of the medium the same resistance although their volume may be very different.

The object of the present improvements is to facilitate the classification and to increase the accuracy and sensitiveness of the apparatus by separating more sharply the classification by equivalence from the classification by density, and by rendering more uniform the feeding and distributing of the ore in the apparatus. They also relate to several details having reference more particularly to the use of automatic fluid-tight boxes for discharging the classified minerals, and to the method of oscillating the column of water of the apparatus in cases of treatment of fine and adhesive materials.

The classifying tube is composed of an upper portion free from any internal organ, designed to effect a preliminary separation of the bodies by equivalence by the action of their own descent, and of a series of superimposed identical classifying elements comprising parts which serve to regulate the course of the classifying current in order to cause it to produce a determined deviation upon each of the species of the bodies to be

classified, and thus to separate them according to their densities. In this arrangement, the ore is charged into the tube at regular and adjustable intervals by a distributor situated at the upper part, while a distributing subdivider situated above the top classifying element serves to spread this ore in uniform sheets and to distribute in a suitable manner the constituent bodies in these sheets.

In the accompanying drawings Figure 1 is a diagrammatic vertical section of a classifying apparatus according to the invention. Fig. 2 is a horizontal section on the line A—B of Fig. 1. Fig. 3 is a part vertical section of the tube illustrating the mode of classification. Fig. 4 is a detail view illustrating the arrangement for removing the classified matter, which consists of an air-tight box acting as an automatic emptying device. Figs. 5 and 6 are respectively detail views illustrating two modifications of the device for producing oscillation of the column of water when finely divided and adhesive materials are being treated. Fig. 7 is a modification of the apparatus when the classification is effected by air. Fig. 8 is an enlarged view in transverse section through the distributing subdivider. Fig. 9 is a face view of the same. Fig. 10 is an enlarged face view of the riffled separator and throttling flap, and Fig. 11 is a longitudinal section of the same from front to back.

The distributor consists of a drum shaped like a truncated cone of wire gauze or perforated metal rotating at uniform speed on its axis and partially immersed in the classifying current, in this case a water current, up to the level *b*. The ore to be classified is introduced into this drum through an axially situated gutter *c*. Around the drum *a* and fixed thereto is a jacket *d* having at equal distances from each other openings *e* which may be closed by sliding shutters *f*. This distributor is for the purpose of dividing up and diluting the ore to be classified. It discharges into the apparatus at regular intervals of time, longer or shorter according to the speed with which the jacket *d* rotates, and according to the number of openings *e* which are uncovered, quantities of ore substantially uniform.

The classifying tube is preferably rectilinear in cross section; its width is a function of the size of the ore under treatment, and its length in section is a function of the power or

output of the apparatus. Its height, which depends closely upon the two dimensions aforesaid, is proportionate to the degree of classification by equivalence which is to be attained. The tube consists of identical classifying elements *g*, and of an extension *h* arranged above the top classifying element. The ore charged by the distributor, classifies itself by equivalence in this extension, and all its constituents thus arrive successively and in their order at the classifying elements in such a manner as to enable these to work to the best advantage.

Above the upper element *g* is a distributing subdivider consisting of an inclined table *i* provided with points *j* arranged quincunxially. This subdivider serves to equalize and to spread the sheet of ore discharged by the distributor, and to form it into a layer of completely uniform thickness, presenting always the same resistance to the action of the classifying current. According to the size of the ore treated the pins *j* are more or less spaced apart.

The classifying elements *g* which are superposed in sufficient number according to the result to be obtained and the number of species to be separated, have at each end a flange whereby they can be connected together or with the upper extension. Their internal surfaces are faced and one of them carries a shoe *k* acting as a controlling device and vertically movable within the tube. This shoe can be fixed at any desired position by an appropriate device. Each element has a flap *m* hinged on an axis *n* and capable of being turned on the latter from without the apparatus so as to change its inclination. This flap may have ribs or riffles normal to the direction of the axis *n* and the deeper the coarser the ore under treatment. The shoe *k* and the flap *m* are for the purpose of throttling more or less the classifying current so as to accentuate or diminish the deviation which this current produces on the course of the substances classified which are descending in the tube at a certain velocity.

The bent plates *o* guide the ore which passes each element and at the same time direct the course of the classifying current. Vanes *p* prevent, when the operation is normal, this current from diverting the ore along these plates and compel it to assume a proper direction. The vanes can be turned on an axis *q* and are independent of each other in the different elements. The vertical portion of the directing plates *o* may be provided at all events in the upper elements, in this case only the first, with horizontal pins *r* arranged quincunxially and having the function of scattering the ore; each element has a chute *s* conducting the classified material to the place of delivery. The top extension *h* also has a chute *s'* through which the valueless materials are discharged, and the bottom

classifying element has a chute *s''* for the discharge of the pure material. This bottom element is also connected with the admission pipe *t* for the air or the water under pressure which is to constitute the classifying current and escapes by the top chute *s'* at the level *b*. The materials discharged through the chutes *s* and *s''* are in the example shown received in elevators *u* which bring them up to the top level above the water.

Instead of elevators there may be used simple boxes tightly closed and having an automatic discharge or not. Fig. 4 shows an example of this arrangement. The chute *s* delivers into a bottomless box *v* slightly conical and resting on a bellows *w* to which the pressure of a column of water in the apparatus is communicated through a tube *x*. When the weight of the material collected in the box *v* exceeds the pressure of the column of water in the apparatus, the bellows *w* collapses, and the material escapes laterally from the bottom of the box. When the latter has been unloaded the bellows expands again and closes the bottom of the box. The discharge is thus automatic. If a tight box without an automatic discharge is used, it may be provided with an air-lock chamber to allow of the material being removed without discharging the column of water in the apparatus.

The apparatus operates as follows:—Assuming for example that the apparatus is being worked with water and by an ascending current, the valve which closes the pipe *t* is first opened, and as soon as water flows through the chute *s'* the distributor is started. The ore then falls through the openings *e* in uniform sheets into the extension *h* being here preliminarily classified by equivalence. The various constituents thus arrive already separated on the table *i* where the descending sheet is spread and equalized before it enters into the classifying elements. There, under the influence of their speed, and under the action of the classifying current controlled by the respective positions of the shoe *k* and of the flap *m*, the uniform sheet *y* (Fig. 3) is laterally diverted and forms a curvilinear sheaf *y'* having the point *l* of the shoe *k* for its summit; and accordingly as the distance between the shoe and the flap *m* is reduced or increased, the sheaf thus formed is increased or diminished. The progress of the classifying current is indicated by the arrows in Fig. 3, and it will be seen that by modifying the form of the sheaf one can arrest at, or allow to pass each element, the desired substance or substances with absolute precision, the separation being effected in the current itself, and therefore practically without any resisting friction.

In normal operation, the substances are then simply diverted more or less from their original direction, but are not carried along

by the current, so that the maximum of sensitiveness is obtained. Nevertheless, if one throttles more and more the current by bringing together the shoe and the flap, at last, working by derivation is attained. It is evident that when operating with this high degree of throttling, the apparatus can only work imperfectly. Nevertheless it may be useful to adopt this mode in the case of very coarse ores which do not lend themselves to sensitive classification. In this case the vanes p may also be completely open so as to increase the action of the classifying current. The same operation is repeated successively in the several elements and the classification is accentuated in proportion as the descent proceeds, as the substances are presented to the action of the classifying current in a condition more and more spaced apart. The vanes p may be adjusted differently in the several elements so as to control the operation in each element to accord with the quantity of matter which the latter receives. Suitable scales on the outside of the apparatus indicate the proper position for the vanes p , the flaps m and the shoes k for producing any desired result.

The apparatus is so adjusted that when the separation of complex ores is to be effected, the useless materials are first discharged in their order by the upper chutes, then the denser metallic constituents also in their order by the lower chutes. Thus the whole of the classification occurs in the water which flows to the upper level b , and no secondary current should be produced by the discharge chutes unless large quantities of water are used, and that it is desired to increase the force of the current. In the latter case elevators having ordinary buckets may be substituted for elevators having perforated buckets. Since the elevators have the same speed and different lengths, there is thus obtained a progressive current in front of the different shoes k , that is to say at each element the current is increased by the quantity of water raised by the elevators of the elements above it. In this manner the discharge of the materials by the chutes is facilitated and the elevators are always kept clean. In any case the derived currents ought never to injure the main current and damage the classification. Since the principle of the apparatus is to produce deviation, that is to say since in normal working there is not to be any carrying of the materials by the classifying current, it is obvious that the current may be either ascending or descending as desired, to suit each case.

In the treatment of very fine and adhesive materials, when it is desirable to facilitate the descent in the apparatus, a vibratory movement of very small amplitude is imparted to the whole column of moving water,

this vibration being insufficient to disarrange the classification.

Figs. 5 and 6 illustrate two advantageous arrangements for producing this vibration. In Fig. 5 one of the walls of the bottom element g is perforated, and against this wall is fixed a flexible diaphragm g' which is pushed outwards by the pressure of the column of water in the apparatus, and to which is fixed a rod carrying a roller which is under the action of the arms of the rotating cam z . An obvious modification of this consists, as shown in Fig. 6, in the substitution of a piston g'' of a large section, for the diaphragm, the said piston working in a lateral tubular by an eccentric z' . In the case of dry and finely divided substances, when the apparatus is operated by air, the whole tube may be suspended from an oscillatory connecting rod z'' (Fig. 7), and the discharge chutes c'' may be sufficiently flexible to allow of the oscillation of the apparatus.

The apparatus has a perfect sensitiveness hitherto unknown in apparatus of this kind. In fact the substances to be classified, endowed with a preliminary known speed for each, may be diverted from the vertical to a precise extent depending exactly on the will of the operator, and may be discharged without any other intervention of the classifying current. Its efficiency is very high due to the very small loss of useful material and because it requires only a very low consumption of power and water for a very large output, and works with practically absolute precision.

Having thus described the nature of my said invention and the best means I know of carrying the same into practical effect, I claim:—

1. Apparatus for classifying solid materials by equivalence and by density, comprising a vertical tube, means for passing a classifying current therethrough, a distributor for delivering the materials into said tube in well defined charges at regular and adjustable intervals, a tubular element free from any internal organ, located below said distributor and in which the materials delivered by the latter are classified preliminarily by equivalence, means for deflecting more or less laterally the various species of the bodies to be classified and thereby separate them by density more and more completely as they descend, and parts for discharging and receiving the classified substances.

2. An apparatus for classifying solid materials by equivalence and by density, comprising a vertical tube, means for passing a classifying current therethrough, a distributor for delivering the materials into said tube, a tubular element free from any internal organ for classifying the materials by equivalence, a series of superposed classifying elements for classifying by density, each of

said elements comprising a vertically movable regulating shoe and an adjustable separating plate or flap located below and arranged to work in conjunction with the shoe to regulate the force and direction of the classifying current, a flap for regulating the output, and means for securing the proper direction of the classifying current, and parts for receiving and discharging the classified materials.

3. A classifying apparatus comprising a vertical tube, means for causing a classifying current to pass therethrough, a distributor located at the upper part of the tube and consisting of a rotating perforated drum surrounded by a casing fixed to said drum and formed with longitudinal apertures through which the ore to be classified falls in sheets at more or less close intervals, a tubular element free from any internal organ, for classifying by equivalence, a distributing-divider serving to regulate the descending sheets of ore, and consisting of an inclined table furnished with pins, means for deflecting the ore laterally under the two-fold action of the classifying current and of their own velocity, and parts for discharging and receiving the classified materials.

4. A classifying apparatus comprising a vertical tube, means for causing a current of water to flow therethrough in a suitable direction, a distributor for delivering the materials to be classified into the tube, a tubular element free from any internal organ, for classifying the materials by equivalence, a distributing-divider at the base of said element, a series of superposed classifying elements for classifying by density located below the tubular element for classifying by equivalence, chutes leading from the said superposed density classifying elements, fluid-tight boxes arranged to receive the ma-

terial from the chutes and yielding counterbalanced bottoms for said boxes.

5. A classifying apparatus comprising a vertical tube, means for causing a classifying current to flow therethrough, a distributor for delivering the material into the tube, a tubular element free from any internal organ, for receiving the material from the distributor, a distributing divider at the base of said tubular element, a series of superposed density classifying elements, means for receiving and discharging the classified substances and means for imparting pulsations to the classifying currents independently of the vessel which contains the current for oscillating the material passing through the current.

6. A classifying apparatus comprising a vertical tube, means for causing a current of water to flow therethrough, a distributor for delivering the material to be classified into the tube, a tubular element free from any internal organ, for receiving the material from the distributor, a distributing divider at the base of said tubular element, a series of superposed density classifying elements, means for discharging and receiving the classified material and a movable surface arranged to press laterally on the column of water below said superposed density classifying elements for the purpose of imparting pulsations of small amplitude to the column of water and thereby gently oscillate the material during the classifying operation.

In testimony, that I claim the foregoing as my invention, I have signed my name in presence of two witnesses, this April third 1907.

RENÉ EMILE TROTTIER,

Witnesses:

LÉON BRANDSTETTER,
CHARLES GIRY.