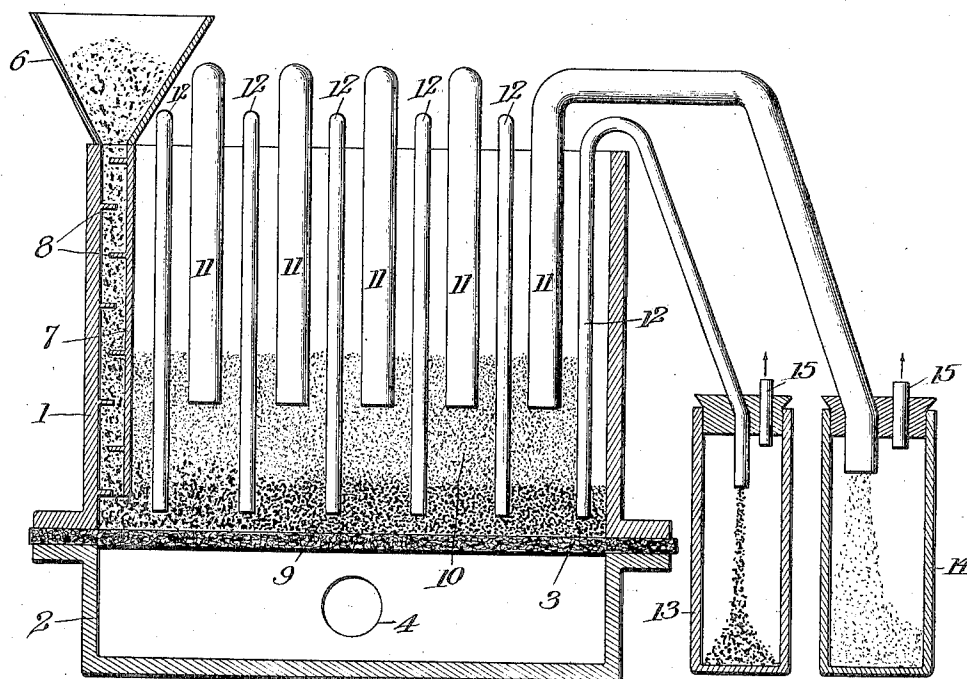


C. J. REED.
 PROCESS OF AND APPARATUS FOR GRADING SOLID MATERIALS.
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UNITED STATES PATENT OFFICE.

CHARLES J. REED, OF PHILADELPHIA, PENNSYLVANIA.

PROCESS OF AND APPARATUS FOR GRADING SOLID MATERIALS.

1,291,137.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, CHARLES J. REED, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Processes of and Apparatus for Grading Solid Materials, of which the following is a specification.

It is known that it is possible under proper conditions to impart to a bed of solid particles such a degree of mobility that they are capable of flowing in a manner essentially similar to the flow of a liquid; and that when such bed is composed of a heterogeneous mixture of differing particles a very perfect grading of the particles may be secured. This grading effect may be obtained not only with mixtures in which the constituent particles differ in density or specific gravity, but also with mixtures in which the constituent particles are similar in quality but differ in size or even in form.

The above-described condition of mobility is obtained when the mass or bed of solid particles is subjected to the action of an upwardly flowing medium of uniform current distribution, the uniformity of the current distribution being maintained throughout the mass. Such a medium may be any suitable liquid or gas, such as water or air. Uniformity of current distribution, as the term is employed herein, does not imply uniformity of current intensity, inasmuch as the liquid or gaseous current may be of uniform distribution, and at the same time may vary greatly in intensity, and may even be intermittent. The medium may flow in waves or puffs, and in many cases it is found that an intermittent current is preferable to a current of uniform intensity. The uniform current distribution of the medium is best obtained by charging the particles to be graded onto a support comprising a layer or layers of porous material of uniform thickness and resistivity, said material opposing a high resistance to the passage of the medium flowing upwardly therethrough, but permitting the medium to flow in a stream of uniform current distribution as defined above.

When the conditions are properly adjusted the mass of solid particles acquires, as stated above, many of the essential characteristics of a liquid. For example the upper surface of the mass or mixture automatically assumes and maintains a horizontal

plane, and if this surface is disturbed by an external force, it quickly resumes the horizontal position, in all respects like a liquid. A vibration imparted to the receptacle containing a mass of particles in this condition will cause a wave to move over the surface of the mass, resembling very perfectly a wave which would be produced on the surface of a liquid subjected to a like vibration. If a solid rod be thrust into a mass of particles in this mobile condition, it will meet with no greater resistance than if thrust into a liquid having a density equal to the density of the mass. In this condition the mixture has no apparent motion as a mass, and even the individual particles have either no motion or so little that it can not be detected except by close examination. Nevertheless, the separate particles press downward so lightly upon the subjacent particles that the mass as a whole assumes the flowing properties of a liquid.

When the mass has been brought to the condition described, the stratification of its particles may be aided by imparting to the container a vibratory motion, although this is not necessary in all cases.

Although in devices of this kind an excellent stratification of differing particles may be obtained, difficulties have arisen in removing the graded particles without mixing them. Attempts to cause the different strata to flow out in a horizontal direction, or in a direction transverse to that of the flow of the medium, have failed. This is particularly true where water has been used as the flowing medium. In order to obtain and maintain the mobile condition which is essential to proper stratification, the flowing medium must not only be of uniform distribution, but must also flow in an upward, vertical direction to a height above the surface of the material to be stratified. If the outlet for any stratum is below this height, the outflow produces a strong approximately horizontal current, which neutralizes or destroys the effect of the upwardly flowing current of uniform distribution, and causes a mixing of the strata.

I have found that a practical separation of the strata may be accomplished by removing the particles in an initially upward direction, that is to say, substantially parallel with the line of flow of the medium, whereby cross currents, or neutralization of the necessary vertical current, may be substantially avoided. For this purpose the

particles constituting the respective strata are withdrawn upwardly through tubes or conduits, preferably under suction. In order to avoid interfering transverse currents, the particles should be withdrawn at a large number of points, the amount removed through a single tube or conduit being very small as compared with the total area of the stratum.

10 In the accompanying drawing, wherein the figure is a central vertical section, I have illustrated in a diagrammatic way an apparatus according to the present invention.

In said drawing, 1 indicates a containing vessel having a removable flange bottom 2, and a porous septum 3, which may be of felt, this septum being securely clamped between the container and its bottom section, and supported and retained in position in any suitable manner, in case the size of the apparatus is such as to require intermediate supports or retaining means. The resistance offered by the septum to the upwardly flowing medium should be greater, and preferably very much greater, than the resistance offered by the overlying bed of particles to be separated, since otherwise slight variations in the resistance of the overlying bed at different points would cause material variations in the current intensity and distribution of the medium at those points, thereby disturbing the uniformity of current distribution which is the essential condition. 4 represents the inlet for the medium, as air or water, introduced under sufficient pressure to produce an adequate upward flow through the septum and the overlying bed of solid particles. 6 is a charging hopper, through which the material is fed, the charging tube 7 leading preferably to a point well below the normal surface of the bed. This tube may be provided with a series of baffles 8 serving to lengthen the path of the downwardly moving particles.

45 The walls 1 of the container extend on all sides above the surface of the mobile bed, and are free from side outlets at or below such surface. The particles are withdrawn in an initially upward direction from the respective strata, indicated at 9 and 10, the particular means of withdrawal chosen for illustration comprising bent tubes 11 and 12, leading to receptacles 13, 14, each provided at its upper portion with an outlet 15 to which a suction device, such as a vacuum pump or other type of exhaustor may be applied. Essentially similar discharge tubes are disposed at close intervals over the area of the apparatus.

60 It should be understood that my invention is not limited to the particular arrangement of discharge conduits illustrated

by way of example, the essential condition being that the particles should be withdrawn from the respective strata in a direction which is initially vertical, being diverted from this direction only after they have been withdrawn from the strata proper.

I claim:—

1. The process of grading heterogeneous mixtures of solid particles, which consists in subjecting said mixture to an upwardly flowing current of a fluid medium substantially of horizontally uniform distribution, controlling the rate of flow of said medium to bring the mixture to a condition of mobility and stratifying the material while in said condition, and removing the particles from one or more of the strata in an initially upward direction.

2. Apparatus for grading solid materials, comprising a porous septum for supporting a bed of such materials, means for causing a fluid medium to flow upwardly through such septum and bed, means for controlling the rate of flow of said fluid medium to cause and maintain stratification of the mixture, and means extending to different depths in the bed for withdrawing particles from said bed in an initially upward direction.

3. Apparatus for grading solid materials, comprising a receptacle having side-walls and a bottom for supporting a bed of such materials, said bottom consisting of a horizontally extending porous septum uniformly resistant to the passage of fluid therethrough, means for causing a fluid medium to pass upwardly through said septum and bed, means for controlling the rate of flow of said fluid medium to cause and maintain stratification of the mixture and means for separately withdrawing the particles of the graded materials from the respective strata in an initially upward direction.

4. The process of grading heterogeneous mixtures of solid particles, which consists in subjecting said mixture to an upwardly flowing current of a medium substantially of horizontally uniform distribution, controlling the rate of flow of said medium to bring the mixture to a condition of mobility and stratifying the material while in said condition and maintaining the uniform horizontal distribution and upward motion of the flowing medium while removing the particles from one or more of the strata.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES J. REED.

Witnesses:

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