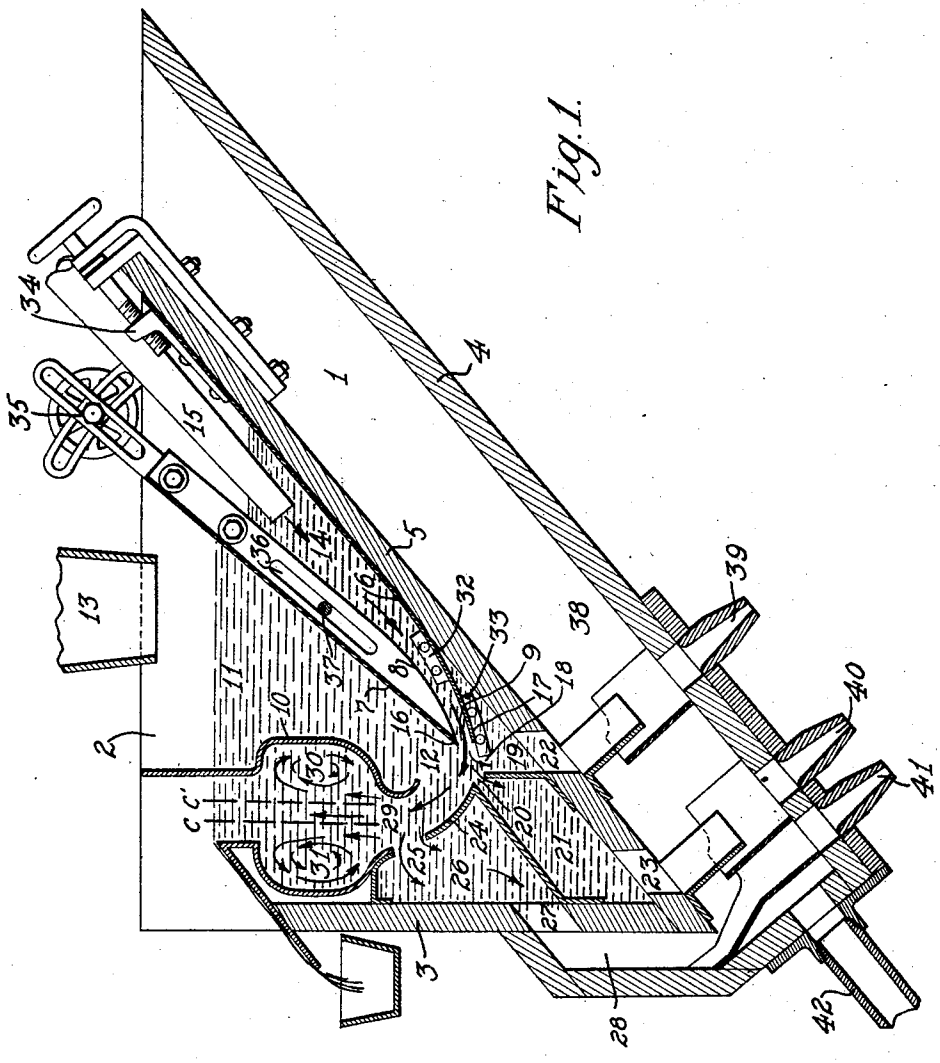
April 12, 1927. S. H. DOLBEAR ET AL 1,624,134

METHOD OF CLASSIFYING CRUSHED ORE AND THE LIKE

Filed Jan. 5, 1922 2 Sheets-Sheet 1

Fig. 1.



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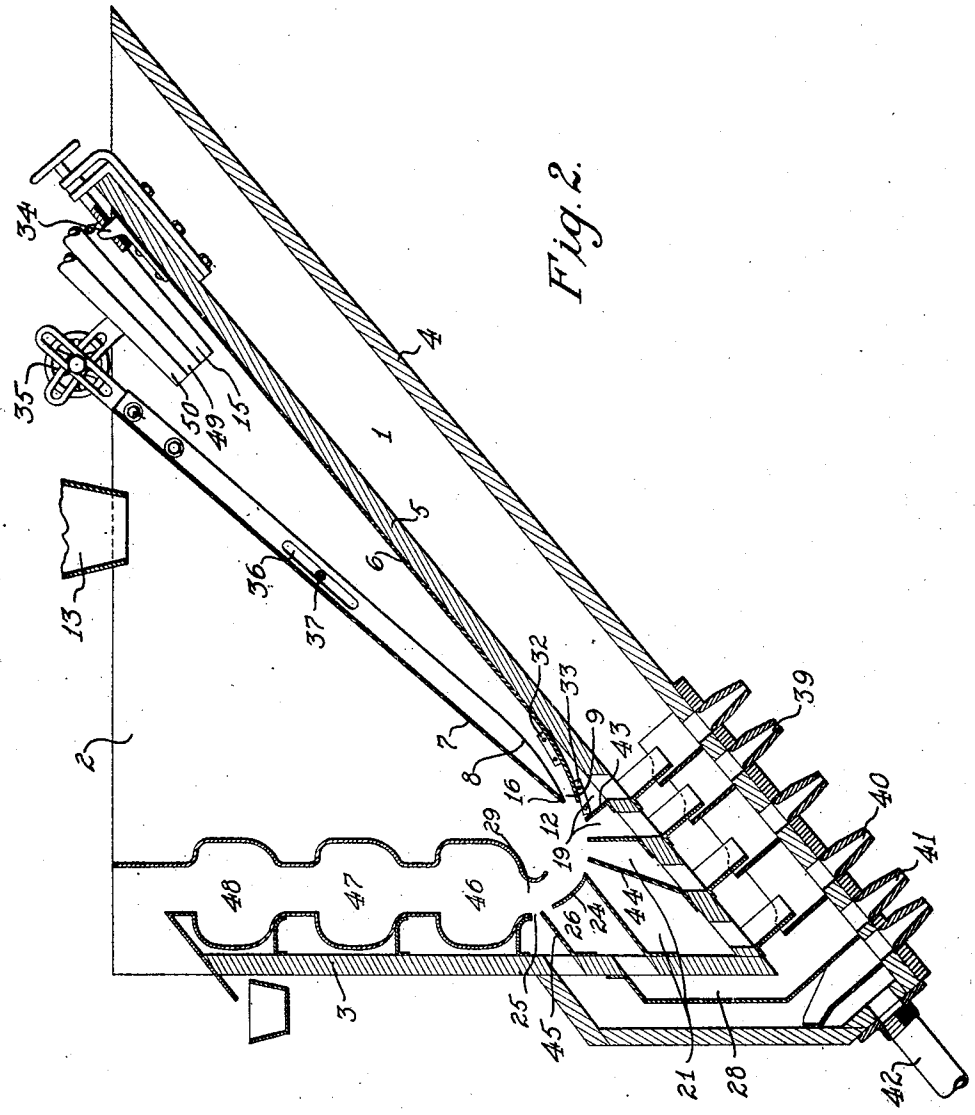
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METHOD OF CLASSIFYING CRUSHED ORE AND THE LIKE

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Fig. 2.



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UNITED STATES PATENT OFFICE.

SAMUEL H. DOLBEAR, OF SAN FRANCISCO, CALIFORNIA, AND BYRON L. EASTMAN, OF NEW YORK, N. Y., ASSIGNORS, BY MESNE ASSIGNMENTS, TO SELECTIVE TREATMENT COMPANY LIMITED, OF MONTREAL, CANADA, A CORPORATION OF QUEBEC, CANADA.

METHOD OF CLASSIFYING CRUSHED ORE AND THE LIKE.

Application filed January 5, 1922. Serial No. 527,164.

The present invention primarily relates to methods of classifying crushed ore and the like, and involves the treatment of crushed ores, rock, coal, gravel, sand, and similar substances and materials; and has more especial reference to the classifying of such substances and materials.

The object of the invention is to effect a separation of particles of such substances and materials into divisions of substantially equal mass.

We are aware that it has heretofore been proposed to classify substances and materials, by (1) passing the same through upwardly-directed currents of water of low velocity; (2) by conveying settled particles upwardly along an inclined plane while overflowing the unsettled particles; and (3) by the use of spitzkasten through which the ore-pulp is passed, a series of such spitzkasten being sometimes employed to collect several products. The apparatus employed in connection therewith, however, depends upon the normal rate of settling of such particles in water. A modification of that type of apparatus is the so-called cone-classifier, in which a current of water is directed upwardly from the center of the cone to hinder the normal settling of the particles.

The present invention is predicated upon the discovery that a jet of fluid—such as water, of relatively high velocity—as compared to currents which have heretofore ordinarily been used—may be utilized to effect a classification, and may be projected over a body of relatively idle fluid, such as water, under conditions whereby the materials of greater mass are first removed and, then, separated from the lighter.

One object of our invention, based on the aforementioned discovery, is to effect the projection of one body of liquid under and in contact with another liquid body.

Another object is to effect the projection of one body of liquid through another.

Still another object is to effect the projection of a liquid body in an approximately horizontal direction.

A still further object is to introduce into the operation a centrifugal effect.

Another object is to hinder the settlement of particles by a stream of liquid directed transversely to the normal course of settling of such particles.

A further object within the contemplation of our invention is to pass particles through relatively still water, whereby certain particles, due to their relative mass, may and will gain greater downward acceleration than others, the particles having such downward acceleration entering a projected body of liquid.

Another object is to take advantage of the circumstance that, at the point where the particles enter the stream, their velocity is less in the direction of the stream than that of the stream itself.

Another object is to take advantage of the circumstance that particles of material will pass through relatively idle water into projected water while a part of the material passes into still water.

Another object of the invention is to take advantage of the circumstance that particles will descend into projected water at a point where such water is approximately horizontal.

Another object is to use a projected stream to accelerate particles at rates varying according to the relative mass of such particles.

Another object is to direct a projected body of water against a surface to deflect or change its initial spouting direction.

Another object is to project a stream having its greatest velocity on one side with decreasing velocity toward the opposite side.

Another object of the invention is to effect a deflecting of projected water from an approximately horizontal plane upwardly to a region beyond its spouting point and utilizing its diminishing velocity for classifying the materials.

Another object is to "underslice" the stream of treating liquid, or effect the direction of a portion of the lower part of such stream, into relatively idle water.

Another object is to take advantage of the circumstance that, upon passing from projected water into relatively idle water beneath, the lighter particles of the mass are deposited farther forward in the direction of flow than the heavier particles thereof.

Another object is to effect contact of rela-

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tively idle water with the side of an up-cast stream at one or more points in its course.

Another object is to up-cast a stream so as to direct it into contact with a body of water having relatively little motion and in closed circuit therewith and so circumscribed that the lower portion of the water converges with the stream, causing solids present in the water to pass downward and be re-engaged by the stream.

Another object is to direct the up-cast stream to an overflow.

With these and other objects in view, the invention involves, inter alia, means for varying the head, velocity, depth, and spouting-angle of a jet of fluid, such as water; means for introducing the material to be treated; means for advantageously utilizing the factors above set forth for accomplishing classification of the materials treated; and means for discharging the classified material after substantially varying the hydrostatic-head in the treatment-cell and without setting up adverse currents which would prevent proper functioning of these factors.

By the utilization of these factors, a close classification of materials may be effected, and it has been found, in actual practice, that our improved material-classifying method has certain important advantages over others heretofore practiced. Moreover, by reason of the fact that the velocity and depth of the induced jet may be increased or diminished at will, by simple controlling means, the method may be utilized for the treatment of a wide range of products, and will more successfully and effectually classify coarser materials than will any other of the classifiers known to us. Furthermore, our method effects a substantial saving in power over other types of classifiers, and may be operated entirely by automatic means. Moreover, the spouting-angle, width of discharging apertures, and other factors are readily controlled.

The method herein contemplated may be practiced in connection with any of a variety of types of apparatus; but experience has shown that that illustrated in the accompanying drawings is practical and successful; hence, we here exemplify it in connection with the disclosure of our inventive-concept.

In these drawings:

Figure 1 is a view in vertical longitudinal section (more or less diagrammatic) of a preferred form of apparatus for practicing our improved method; and

Fig. 2 is a view of a modified type of structure.

This apparatus—which, as aforementioned, may be of various forms, dimensions, and capacity—essentially comprises a cell or container 1 having side-walls 2, a front-wall 3 and an inclined bottom 4.

Extending in parallelism with the bottom 4 is a division-wall 5, upon the upper surface of which is mounted a fluid-directing member or plate 6 which, at its lower end, is curved, as shown.

Overlying and spaced apart from the plate 6 is an adjustable fluid-directing member or plate 7 having a curved lower surface 8. The curved surfaces of the plates 6 and 7 are so related and dimensioned as to form a spout as at 9.

Angularly disposed to the member 7 is a downwardly-extending division-wall 10, and this, with the plate 7 and the sides of the wall, constitute a chamber 11 which, at its lower end, adjacent the spout 9, is open, as at 12, for a purpose presently to be explained.

Extending into or otherwise communicating with the chamber 11 is a hopper 13. The material to be treated is delivered through this hopper and, thence, into the chamber 11 which contains relatively idle water. The material-particles settle upon the surface of the plate 7 and gravitate towards the lower end thereof, gaining momentum in their downward travel according to their relative mass. Water under sufficient head is delivered to a space or passage 14, formed between the plates 6 and 7, through a pipe 15, it passes downwardly through the passage 14, and it, thence, is projected through the spout 9.

As will be noted, the curved surface of the plates 6 and 7 will serve to turn the stream, developed through the passage 14, into an approximately horizontal course as such stream leaves the spout 9, and it then travels tangent to the points 16 and 17 following the directing influence of the spout 9.

The ratio of the curve of the surface of plate 6 is greater than that of plate 7, and this is because the stream from the spout 9 has a somewhat greater velocity at point 16 than at the point 17. The material to be treated will have entered the projected stream at 12 and, due to its velocity, only the heavier particles of the material will pass through the stream immediately. Some of the particles, upon passing through the stream, have a greater forward movement than others, this being due to the difference in mass and the aforementioned velocity imparted to them by the stream. Those of the greater mass immediately drop through a passage 18 into a chamber 19, while others have a greater forward motion and travel beyond the passage 18 to an opening 20 of an associated chamber 21. From these chambers 19 and 21, respectively, the said material is discharged through ports 22 and 23, respectively, in the division-wall 5, thus resulting in two products of relatively different mass. Such particles as may still be retained by the water,

after passing through the spout 9, are projected upward and against a baffle 24 which functions to impart a centrifugal effect to the stream. Upon then arriving at the opening 25 of a chamber 26 containing a body of relatively idle water, the directed water comes into contact with the relatively idle water in this chamber 26, whereupon those particles which have been drawn to or forced towards the side of the stream by the aforementioned centrifugal effect pass into the chamber 26, thereby making a third product. This product is discharged through a port 27 into a passage 28 and is then handled in a manner presently to be explained.

The stream, still under considerable head, may retain some of the finer particles of the material; hence, we arranged to have this carried by the stream, along a continued upward course indicated by the dotted lines C and C′, through an opening 29 into chambers 30 and 31. These chambers are filled with water having relatively less motion than the stream, and are provided for reclassification of particles which have passed the opening 25 of the chamber 26 but which are of too great mass to be readily overflowed from the cell. The particles, on dropping out of the stream on the discharge-side of the cell, sink toward the lower part of the chamber 31 which converges with the stream, and are re-engaged thereby. Ultimately, they either then sink into the chamber 26 or are overflowed from the chamber 31. The particles passing into the chamber 30 pass downward toward the point of convergence of the stream where they are similarly re-engaged and are then either overflowed or passed into the chamber 31 and ultimately delivered therefrom into the chamber 26.

To provide for the raising or lowering of the plate 6—the curve of which is made constant by the guides 32 and 33 between which the plate is adjustably disposed—a screw-operated adjustment-device 34 is attached to the upper end of the plate. Its operation effects a predetermined adjustment of the plate 6.

Similarly, the plate 7 may be relatively moved by an adjusting-device 35. For such adjustment, the plate is provided with a longitudinal slot 36 in which a pivot 37 works. By operating the adjusting-device 35, the plate 7 may be shifted longitudinally, the pivot 37 (moving in the slot 36) serving to guide the plate for such movement; or, the plate may be moved laterally upon the pivot 37.

The purpose of providing for the foregoing adjustments is to vary the depth of the stream, to vary the spouting-angles at 9, to vary the width of the aperture or opening 18, and to vary the angle of the upper surface of the plate 7 in respect to the member 6 for facilitating or retarding the feed or travel of the material along its surface.

The products discharged through the ports 22, 23 and 27, respectively, may be delivered into a sump 38 having the same hydrostatic head as the above-described classifying cell, and they may then be elevated from such sump by worm-conveyors, (not herein shown), elevators, or similar well-known means, or may be discharged from the sump through nozzles or spouts 39, 40 and 41, respectively, such sump being so arranged as to maintain a hyprostatic head therein as great or slightly greater than that of the cell itself. Under these conditions, the water necessary to discharge the settled products is supplied by a pipe 42, with the result that the classified material is discharged without lowering the level of the water in the classifier-cell, itself, or causing currents to pass through the chambers 19, 21 and 26, which currents would obviously be adverse to classification.

If desired, the lower edge of the plate 6 may be lowered slightly to "underslice" the projected water; that is, to divert a small part of the lower portion of the stream into the chamber 21. Similarly, the wall or plate 24 may be slightly depressed to divert a portion of the stream in the chamber 26. This would result in supplying water sufficient discharge the classified product without setting up adverse currents or lowering the hydrostatic level in the cell.

It is to be understood that the apparatus herein specifically revealed is a very practical one for carrying our invention into effect; nevertheless, other suitable types of apparatus, embodying the same underlying features as those hereinabove pointed out, may be utilized; and, in the disclosed apparatus, changes may be made in various mechanical features thereof without departing from the spirit of the invention: For instance, as shown in Fig. 2, partitions 43 and 44 may be disposed in the chambers 19 and 21 to effect a further division of products; moreover, the chamber 24 may be divided by partitions 45 to effect a further division of the products deposited therein. Similarly, a series of superposed chambers 46, 47 and 48—similar to the chambers 30 and 31—may be provided. In some instances, the chambers 30 and 31 may be combined into one chamber.

If it be found desirable to accentuate the difference in the velocities of the liquid at various points in the stream, either horizontally or vertically, a plurality of jets 49 and 50 (Fig. 2) may be employed, one positioned above another, and situated at one or more points above the path of travel of the stream, such jets having equal or different velocities.

For the purpose of this disclosure, we

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herein define "crushed material" as including rock, coal, ore and all other substances, the integral components, character and size of which are such that they may be treated by the present method. Such crushed material may exist in a sufficient state of subdivision to permit treatment by this method without being actually crushed prior to the treatment thereby, as for example, sand, gravel, rock detritus, etc. Such size may be five-tenths of an inch in diameter or even larger, depending upon the depth and velocity of jet employed. Any suitable crushing operation, as a preliminary to utilizing our method, may be resorted to where the material requires crushing or reducing.

The terms "jet of water", "jet of liquid", and similar expressions, as herein used, define, and are intended to define, a sheet of water projected through a body of water and submerged therein, such jet being confined on one or more sides by a solid and, on one or more sides, by liquid, and having one or more functioning points at which its path of travel is approximately horizontal.

What we claim is:

1. The method of classifying crushed material which consists in bringing the same into contact with a jet of water, then diverting the course of the jet upwardly into contact with a body of relatively still water, and then causing the projected water to yield a part of its load by centrifugal effect.

2. The method of classifying crushed material which consists in bringing the same into contact with a jet of water and diverting the jet upwardly into contact with a body of water having relatively less motion and in closed circuit with the jet, whereby certain particles of the material pass from the jet into the body of water and, then, are caused to be reengaged by the jet.

3. The method of classifying crushed materials which consists in depositing the same in a body of relatively idle water superposed above and in contact with a jet of water having an approximately horizontal course, the jet being superposed above and in contact with a second body of idle water; causing certain of the materials to pass into the second body of relatively idle water; subsequently deflecting the jet upwardly to cause a centrifugal effect; bringing the jet into contact with a third body of relatively idle water to cause certain of the materials to be deposited therein by centrifugal effect; subsequently bringing the jet of water into contact with a body of water having relatively less motion than the jet and in closed circuit therewith; causing certain of the materials to pass from the jet into the latter body of water and to be subsequently re-engaged by the jet; and overflowing the jet.

In testimony whereof we affix our signatures.

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BYRON L. EASTMAN.