Oct. 14, 1924. 1,511,643

L. C. TRENT

HYDRAULIC CLASSIFIER

Filed Oct. 21, 1921 2 Sheets-Sheet 1

Fig. 1.

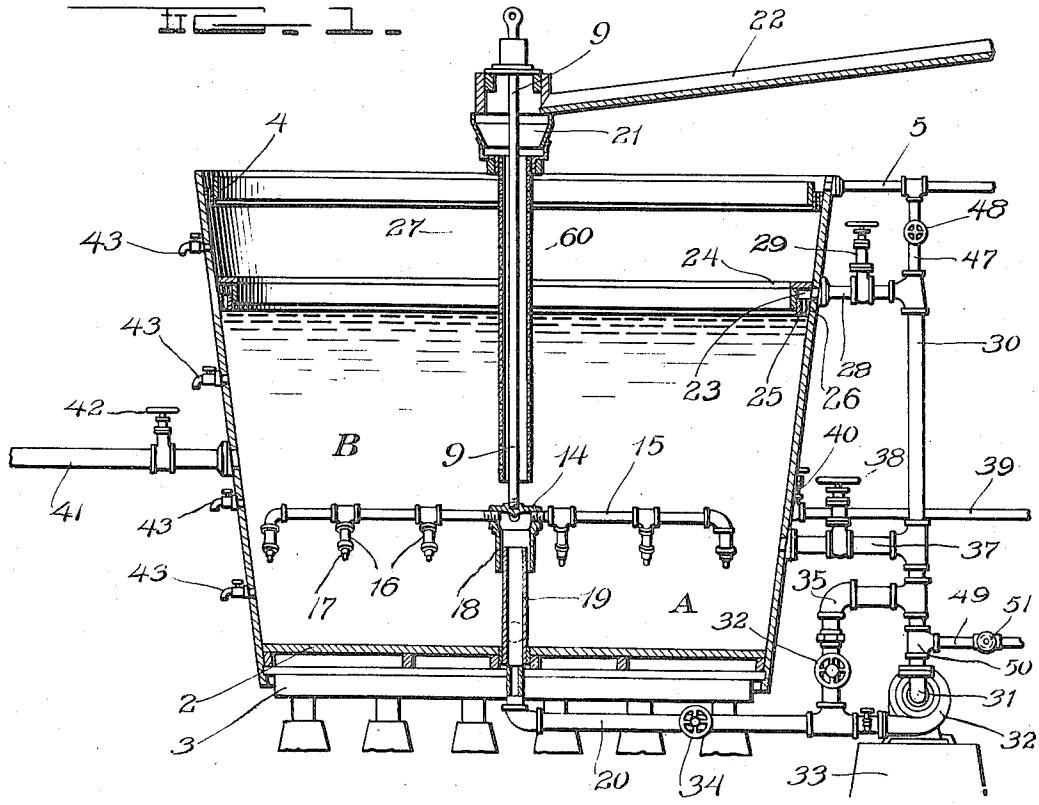
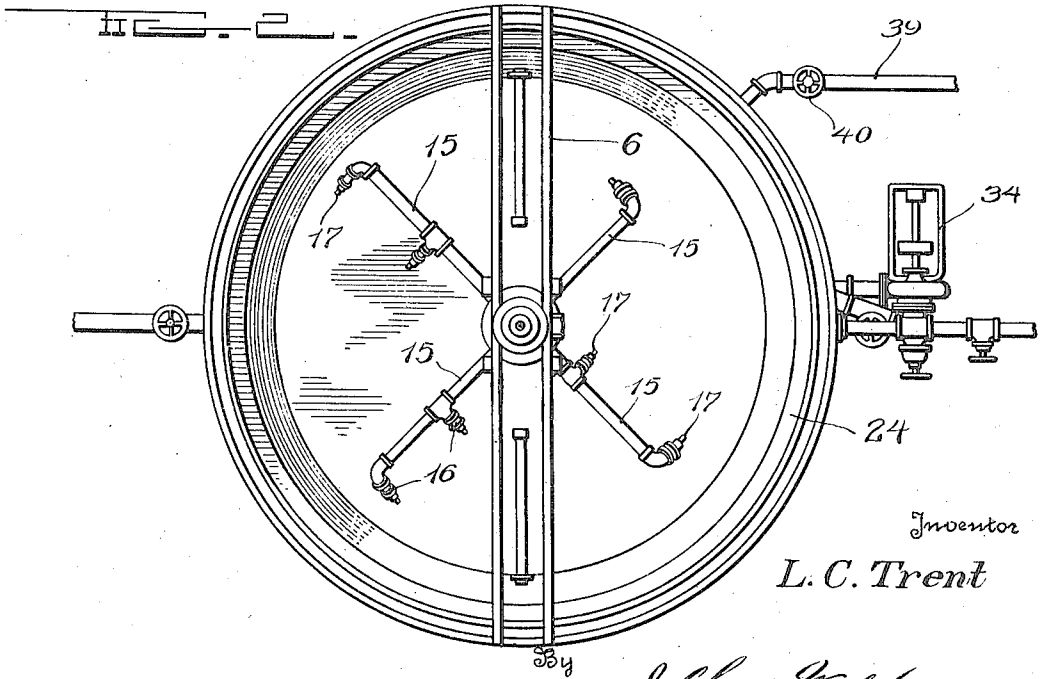


Fig. 2.



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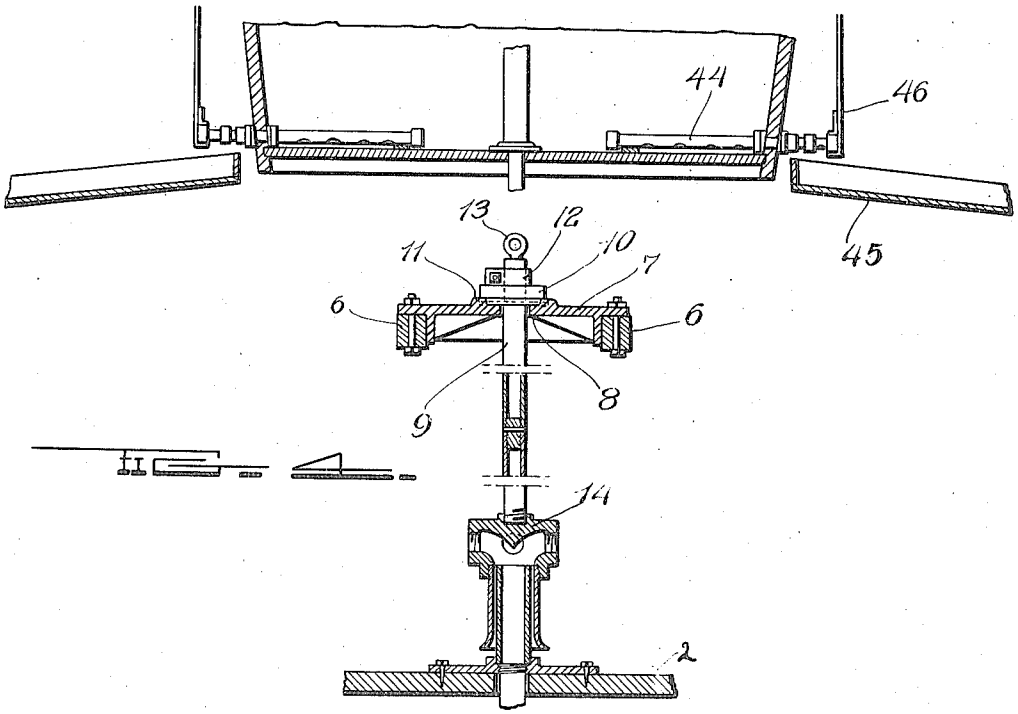
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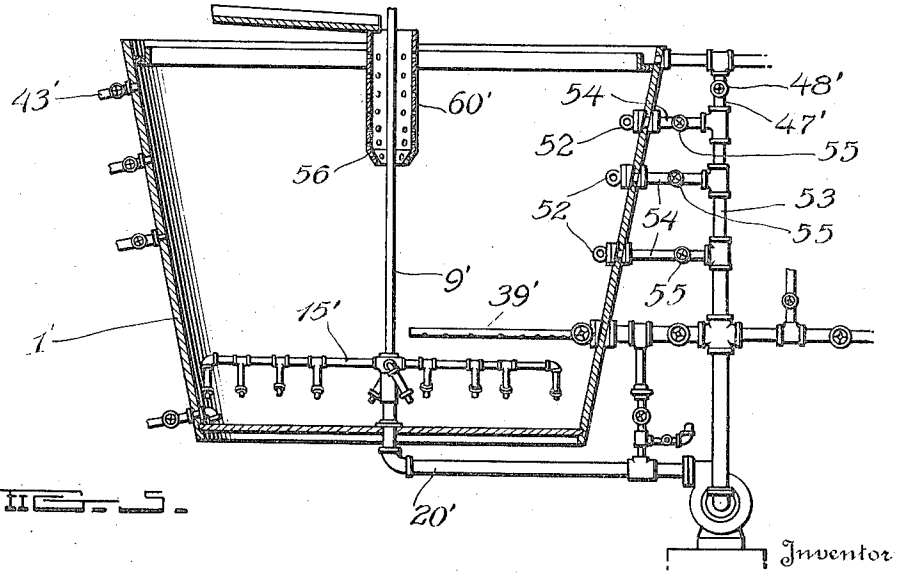
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Patented Oct. 14, 1924. 1,511,643

UNITED STATES PATENT OFFICE.

LAMARTINE C. TRENT, OF WASHINGTON, DISTRICT OF COLUMBIA.

HYDRAULIC CLASSIFIER.

Application filed October 21, 1921. Serial No. 509,317.

To all whom it may concern:

Be it known that I, LAMARTINE C. TRENT, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in a Hydraulic Classifier, of which the following is a specification.

The invention relates to a process for classifying and separating different sized particles from a mixed flow of mineral matter, such as that flowing from crushing and pulverizing machines, used in the refining of coal and various ores.

The primary object of the invention is to classify and separate different sized products, such as coal, ores, and various minerals.

The invention has particular reference to the classifying of the various sizes in refining coal, and is particularly valuable in the preparation of fine coal for use in connection with the Trent process.

Another object of the invention is to classify the various sizes of the ground coal and at the same time to concentrate or thicken the various classifications.

A further object of the invention is the provision in a hydraulic classifier, of means for regulating the classification of the ground material.

With these general objects in view, and such others as will be apparent from the description, my invention resides in the novel construction, combination, and arrangement of parts, and the process hereinafter described and claimed, and taken in connection with the accompanying drawings, of which:

Figure 1 is a vertical section of my improved classifier;

Figure 2, a top plan view thereof;

Figure 3, a detail vertical section of the bottom of the classifier;

Figure 4, a detail vertical section of the agitating mechanism employed; and

Figure 5, a vertical section of a modified form of classifier.

In grinding coal in a wet state sufficiently fine for certain methods of refining, it is necessary to grind it to extreme fineness after it has been partially crushed to sizes not exceeding one-half inch in diameter, and when reduced to such size it must be delivered into a classifier which will remove the released impurities existing in the coal, comprising slate, shale, and other rocks, which are incombustible and valueless, and being harder, are difficult to grind and separate. The classifier must separate the coal into three or more products, namely the undersize, which is extremely fine and capable of passing a two hundred mesh screen, the oversize, which is to be returned to the fine grinding machine for a finer grinding, and the coarse impurities, consisting of stone and incombustible mineral particles usually containing iron pyrites, the principal source from which coal becomes contaminated with sulphur.

My improved classifier is so constructed as to accomplish this classification in a novel and efficient manner and is so arranged that an exceedingly fine degree of adjustment may be obtained for the regulation of the classification, whereby a practically pure product is obtained in the final step of the process.

In detail, the invention comprises a tank 1 having a flat bottom 2 and provided with tapering side walls. In the preferred form of the invention, the tank is preferably cylindrical, the walls thereof sloping outwardly from the bottom to the top, as clearly illustrated in Figure 1. The tank is mounted on a suitable supporting base 3, and is provided at its top edge with an annular trough 4 disposed on the interior of the tank, substantially flush with the top thereof and adapted to receive the overflow containing the finely ground material which it is desired to recover, and which is carried away from the tank by means of a pipe 5 disposed at the top of the tank. Extending across the top of the tank is a pair of supporting beams 6 suitably disposed for carrying thereon a plate 7 secured to the beams and disposed above the center of the tank. The plate 7 is provided with a central bore 8 adapted to receive therethrough a depending shaft 9, which may be formed of pipe sections, or solid if desired, and which is supported on the plate 7 by a ball bearing 10 disposed in a raceway 11 on the upper face of the plate and retained in position by means of a clamping collar 12 on the upper end of the shaft. This construction provides for a free suspension of the shaft 9 within the tank and permits of a free rotation of the shaft. The upper end of shaft 9 is provided with an eye 13 whereby the shaft may be raised or lowered for vertical adjustment when desired. The lower end of the shaft extends down into the tank for a considera-

ble distance, and is threaded or otherwise suitably secured to a five way pipe joint 14, carrying four distributing pipe sections 15 extending laterally therefrom, said sections having at spaced intervals thereon depending nozzles 16 disposed at an angle of approximately 65 to 67 degrees, the lower ends of the nozzles being provided with jet tips 17.

The lower end of the joint 14 is threaded to receive a sleeve 18 depending therefrom and engaging over the upper end of an inlet pipe 19 extending upwardly through the bottom of the tank and in connection with an inlet supply pipe 20 at the exterior of the tank. The sleeve 18 is of a sufficient internal diameter to provide for a spaced relation between the sleeve and the upper end of the pipe 19, whereby free rotation of the distributing members 15, may be obtained.

Surrounding the upper end of the shaft 9 in spaced relation, and extending downwardly from the top of the tank to within a short distance above the joint 14, is a perforated cylindrical casing 60 in connection at its upper end with a hopper 21, disposed beneath a feed launder 22, from which the ground material to be classified is fed into the tank.

A short distance below the top of the tank, an annular suction pipe 23 is disposed on the interior of the tank, being formed of a wooden casing 24, the wall of the tank forming one wall of the casing. The bottom 25, of the casing, is provided with a plurality of spaced apertures 26 forming intakes, and the entire pipe 23 is in connection with the water circulating system by means of a pipe section 28, provided with a valve 29, and in connection with a pipe 30 extending downwardly to the inlet end 31 of a force pump 32 mounted on a suitable base 33 and adapted to be driven by suitable motor mechanism 34. The pump 32 is connected at its outlet end with the tank inlet pipe 20, which is provided with a valve 34, and arranged between the inlet and outlet connections of the pump is a by-pass 35 controlled by a valve 36. Adjacent the lower end of the tank an outlet pipe 37 extends from the tank into the pipe section 30 of the water circulation system, and is controlled by a valve 38 whereby the circulation may be regulated. Suitably arranged adjacent the lower end of the tank is an outlet comprising a pipe 39 controlled by a valve 40, which extends into the tank and is adapted to carry away the oversize particles for regrinding, after which they are returned to the classifier.

A discharge pipe 41 is arranged substantially midway of the tank and in connection with the interior thereof for carrying off the classified material in a thickened condition, and is controlled by a valve 42. At suitably spaced intervals, tap nozzles 43 are disposed in the walls of the tank whereby the degrees of classification and concentration at various levels in the tank, may be determined. The impurities are adapted to be discharged from the tank through perforated discharge pipe members 44 extending into the bottom of the tank at suitably arranged intervals, and disposed along the bottom, the outer ends of these pipes 44 being disposed over troughs 45, and controlled by means of valve mechanism 46 whereby regulation of the discharge may be obtained. The pipe section 47 connects pipe 30 with the discharge pipe 5 and a valve 48 is disposed in this section 47, for regulation of the flow therethrough, as desired.

A normal circulation of water within the tank and the various connections, is set up by operation of the pump 32, whereby water will be pumped into the tank through the pipe 19, joint 14, distributing sections 15 and nozzles 16, toward the bottom of the tank from which it will flow upwardly to the suction inlets 26, through pipe 23, pipe 28, and back through pipe 30 to the inlet end of the pump. This is the normal circulation within the apparatus, and as a means of regulating the classification of the ground material circulated with the water, and held in suspension therein, I provide for the admission of extraneous water into the system by means of an inlet pipe 49 connected with the system by an elbow 15 disposed adjacent the inlet end 31 of the pump, and controlled by a valve 51.

In the modification illustrated in Figure 5, in which parts similar to those of the preferred form are indicated by primed numerals, the construction of the various elements of the device is the same, substantially, as in the preferred form; the tank 1′ being provided with the taps 43′, distributing pipe sections 15′, shaft 9′, and inlet connection 20′. The discharge for the coarse material to be reground, comprises in this instance, a perforated pipe 39′ extending into the interior of the tank. In this modified form the circulation is controlled by suction nozzles 52 extending into the tank at vertically spaced intervals and in connection with the pump return pipe 53 by means of sections 54 controlled by valves 55. The casing 60′ at the top of the tank is provided in this form, with a reduced lower end 56, the construction of the apparatus being in all other respects, substantially that of the preferred form.

In operation the tank is filled with water being circulated therethrough by operation of the force pump 32 in the manner described. The crushed coal to be classified is introduced from the feed launder 22, through hopper 21, down through the casing 60 into the tank, whereupon the finer prod-

ucts will be extruded through the perforations in the casing and the heavier material will be discharged at the lower end of the casing above the joint 14, settling on the bottom of the tank at the center and surrounding the inlet pipe 19 to form a stratum A of the heavier material. Due to the force with which the water is caused to enter the tank, and the inclination of the nozzles 16, these nozzles and pipe sections 15 will be caused to rotate and the jets of water from the tips 17 will be directed downwardly, impinging against the bottom of the tank, cutting through, loosening, and agitating the stratum of coarse material accumulated on the bottom of the tank. The upward flow of water rising through the bed of agitated material will carry with it the finer particles of the coal, upwardly towards the suction intakes 26, through which the material will be returned through pipe 30 and pump 32 to the classifier. Above the bed of impurities resting on the bottom of the tank and below the suction intakes, a stratum of particles will be formed, as indicated at B, consisting of material too heavy to be carried upward to the suction intakes 26, and too light to remain in the bottom stratum of impurities. This stratum B comprises the oversize material and from this stratum the material is drawn off through the pipe 39 and returned to the grinding mechanism from which it is, in turn, returned to the tank through the feed launder 22 for reclassification after regrinding. Ordinarily the fine material which it is desired to recover, would be carried through the suction intakes 26 owing to the fact that above the pipe 23 there is no circulation of water within the tank. As a means of recovering the extremely fine particles, extraneous water is admitted into the system by means of the pipe 49, the supply thereof being controlled by the valve 51, whereupon an excess of water will be supplied to the tank, which will cause a current to rise above the suction pipe 23 and overflow into the trough 4, carrying with it the fine particles. In proportion as the extraneous water is admitted into the circulation system, the suction volume at the intakes 26 will be decreased and the upward flow of the water above the pipe 23 will be sufficient to carry with it only the extremely fine particles to the trough 4, from which they are carried from the tank and system by means of the pipe 5.

In the modified form shown in Figure 5, the principle of operation is the same, except that the suction is controlled from various levels within the tank by means of the outlets 52 as described.

The impure and coarse particles resting on the bottom of the tank may be drawn off from time to time through the discharge pipes 44, whereby the impurities will be extracted from the material to be refined, eliminating any possibility of such impurities being carried to the grinding mechanism.

The classifier is susceptible of very fine degrees of adjustment according to the manipulation of the various valves of the system, and the admission of extraneous water thereinto. Many factors enter into the adjustment and control of the classification, such as the speed at which the agitating mechanism, comprising the pipe sections 15 and nozzles 16 is caused to rotate, the amount of extraneous water admitted into the system; the control of the suction through pipe 23; manipulation of the by-pass 35 through its valve 36; control of the rate at which the oversize is returned to the grinding mechanism, by means of the valve 40; and the rate at which the material to be classified is fed through the feed launder and hopper. All of these foctors have a material bearing upon the degree of classification set up within the tank, as any adjustments therein will affect the velocity at which the particles are carried through the tank, the consequent change in the velocity having a material effect on the formation of the various strata. The pulsating action of the water jets from the depending nozzles, disintegrating the stratum of heavy material on the bottom of the tank, will cause the various strata to be formed and concentrated according to the specific gravity of the materials and particles comprising the strata, whereby the machine becomes in effect, a concentrator as well as a classifier. If desired, the material having reached a certain degree of classification and concentration, may be drawn off through the pipe 41.

While I have shown and described certain details and materials which enter into the construction and operation of the invention, and referred in detail to the various steps of the process, I desire it to be understood that I do not intend to limit myself to these, but that any such may be made use of as will fall within the scope of the invention as claimed.

I claim:—

1. A process for hydraulic classification of ground material, comprising circulating water upwardly through a receptacle, feeding said material downwardly into said receptacle, agitating the material collecting on the bottom of the receptacle, controlling the circulation of said water by admission of extraneous water into the system, and drawing off at certain points of the system the material held in suspension therein.

2. The process for hydraulic classification of ground material, comprising circulating water upwardly through a tank having an open top and provided with an inlet in the

bottom thereof, and an outlet below the top for the water of the circulation system, feeding said material by action of gravity into the tank against the upward flow of water therein whereby parts of said material will be held in suspension, agitating the material in the tank by directional flow of water therethrough, admitting extraneous water into the circulation system whereby an adjustable even flow of water will be secured at the top of the tank for carrying off extremely fine particles of the material held in suspension, and drawing off at certain other points in the tank, the material held in suspension therein.

3. A process for hydraulic classification of ground material, comprising feeding said material into a circulating liquid system, against the flow thereof, controlling the rate of circulation of said system whereby the material may be held in suspension at different points, according to the variation of the rate of circulation, concentrating certain portions of the material at certain points in the system, agitating said concentrations by directional flow of the liquid, and drawing off at certain points of the system the material held in suspension therein.

4. A hydraulic classifier comprising, a tank having an open top, closed bottom and outwardly diverging side walls extending from the bottom of the tank, a rotatable spider disposed on the botom of said tank, nozzles projecting downwardly from said spider, a water supply conduit connected through the bottom of said tank to said spider, means for feeding ground material into the top of said tank above said spider, means for drawing off water at certain portions of said tank and returning same to the water supply conduit, means associated with said conduit for maintaining a continuous circulation of water through the tank, said nozzles being so arranged as to cause a directional flow of the water for separating the ground material into zones according to specific gravity, and taps in the walls of said tank for drawing off the material from the various zones as desired.

5. A hydraulic classifier comprising, a receptacle comprising a tank having an open top and closed bottom with outwardly diverging side walls, a rotatable spider disposed on the bottom of said tank, a water supply conduit associated with said spider for rotating the same by action of water supplied thereto, means for circulating the water through said conduit, spider and tank in a continuous system, a perforated feeding pipe disposed in the tank above said spider for the reception of ground material to deliver the same within the tank, said spider being disposed within the tank to agitate the ground material therein by directional flow of water issuing therefrom, and means in the walls of the tank for drawing off material held in suspension at different levels.

In testimony whereof I affix my signature.

LAMARTINE C. TRENT.