F. K. HOOVER & A. J. MASON.

HYDRAULIC SEPARATOR.

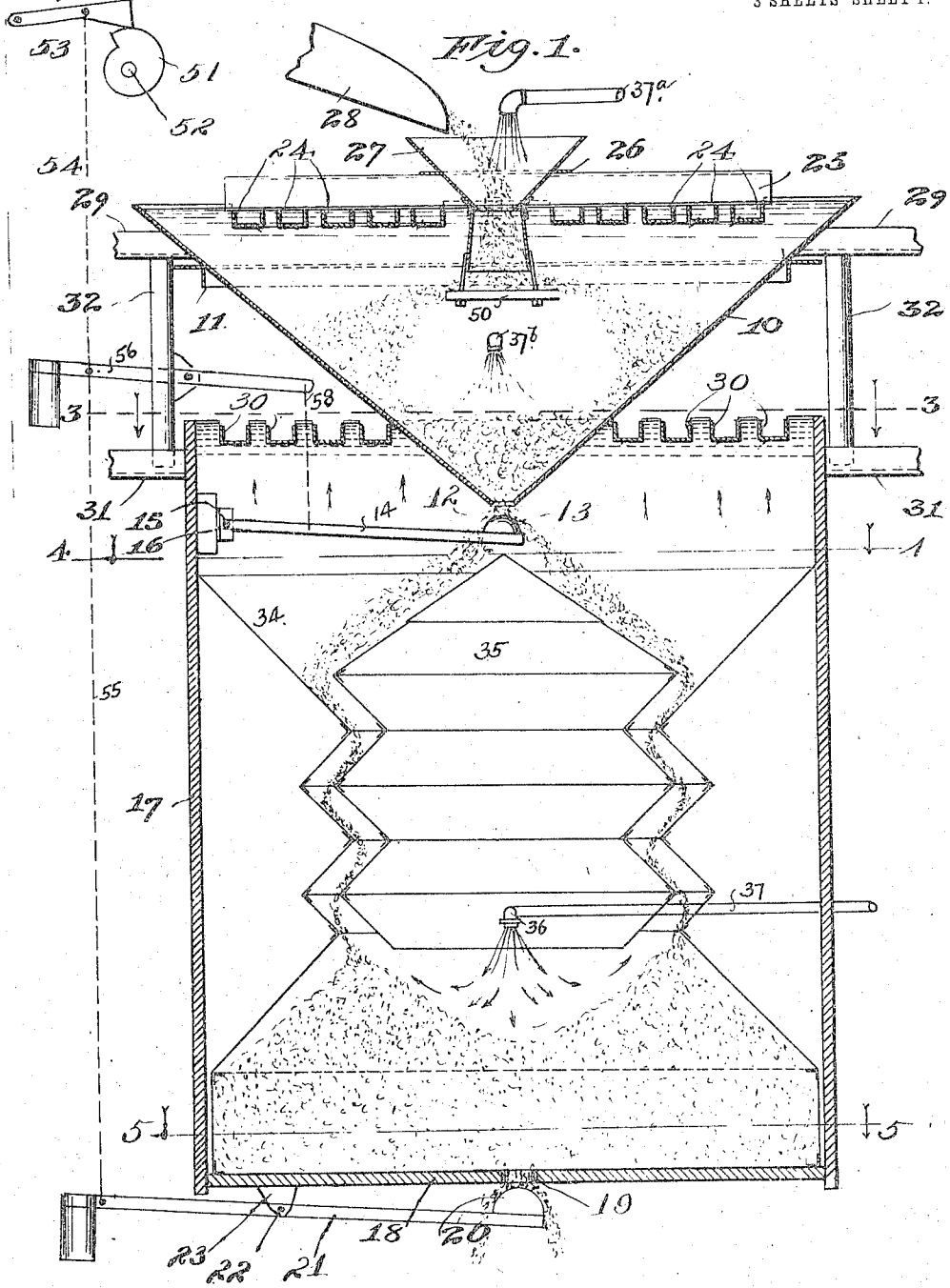
APPLICATION FILED JUNE 9, 1911.

1,128,875.

Patented Feb. 16, 1915.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses.

S. S. Mann,

S. N. Pond.

Inventors,

Frank K. Hoover,

Arthur J. Mason.

By Offield, Towle, Graves & Offield,

Attys.

F. K. HOOVER & A. J. MASON.

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3 SHEETS—SHEET 2

Fig 2

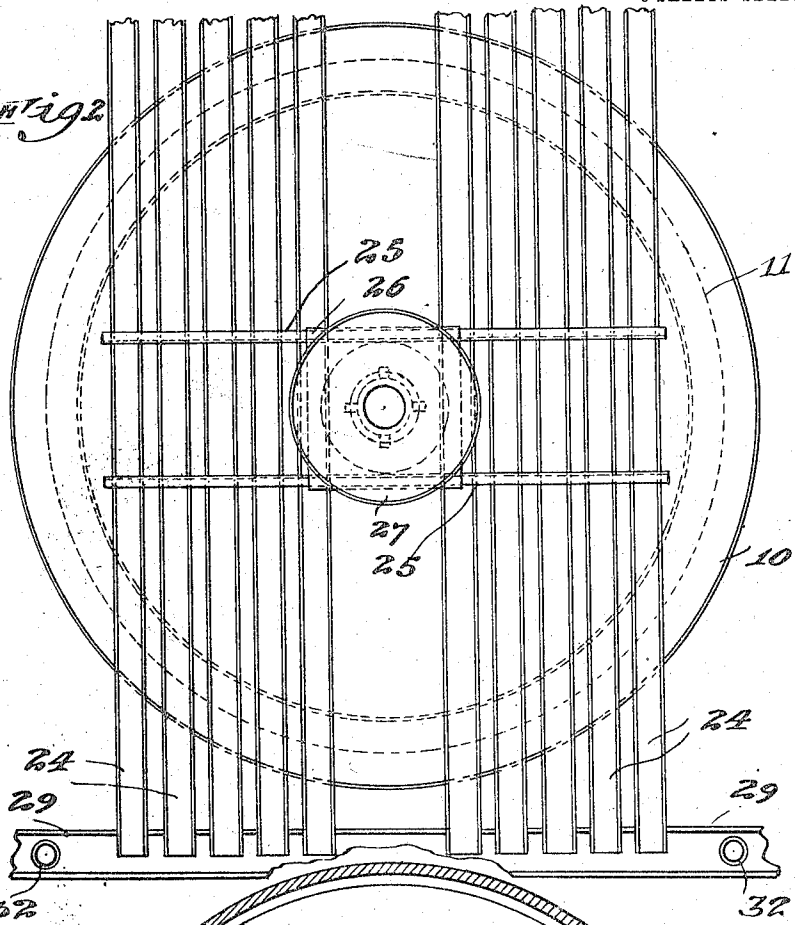
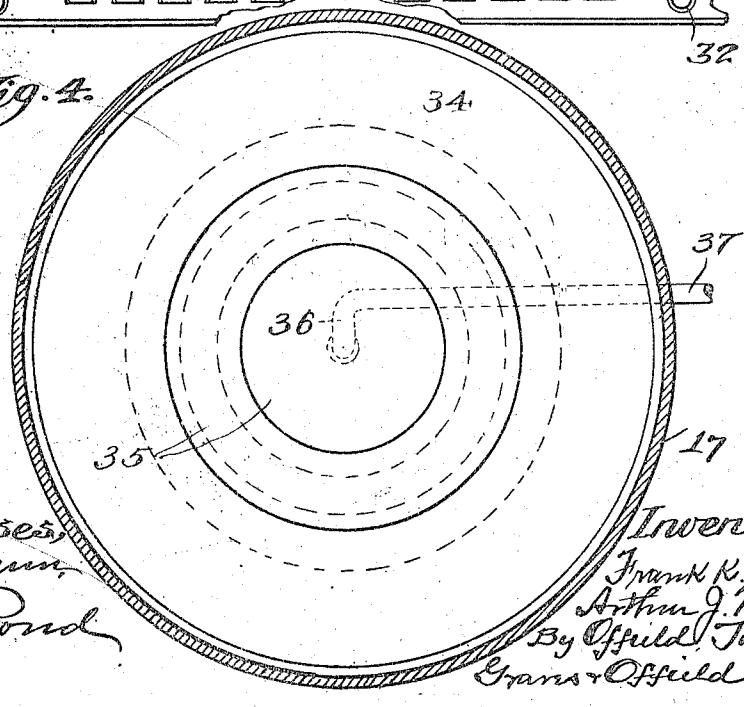


Fig. 4.



Witnesses,
L. B. Mann,
S. N. Pond

Inventors,
Frank K. Hoover,
Arthur J. Mason
By Offield Towle,
Graves & Offield Att'ys.

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3 SHEETS—SHEET 3.

Fig. 3.

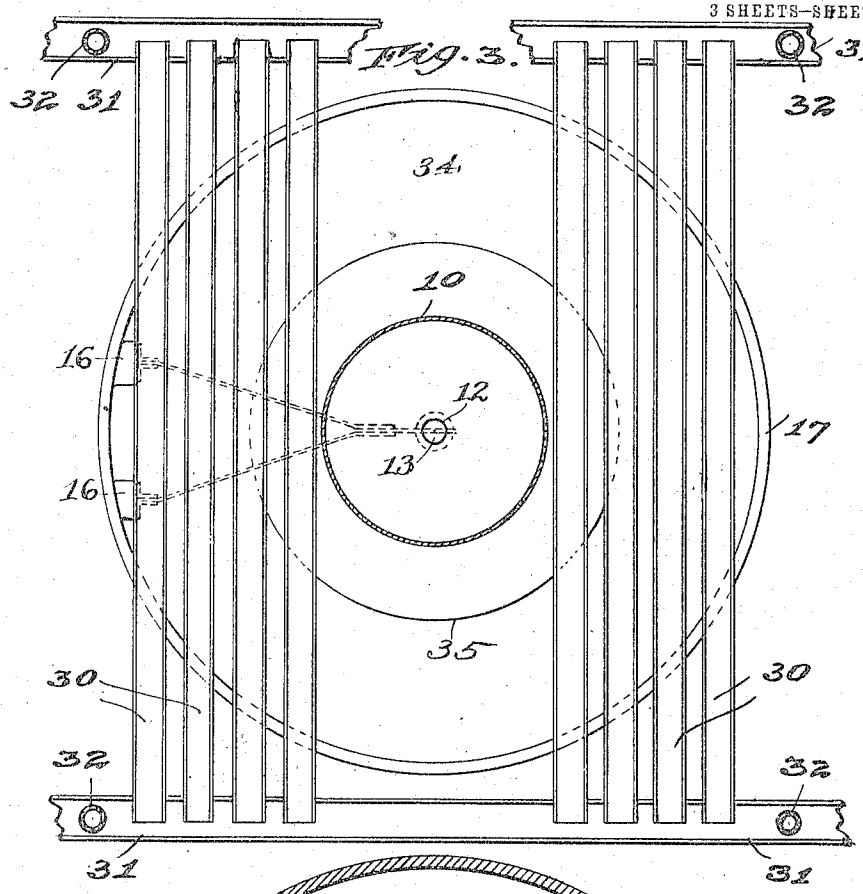
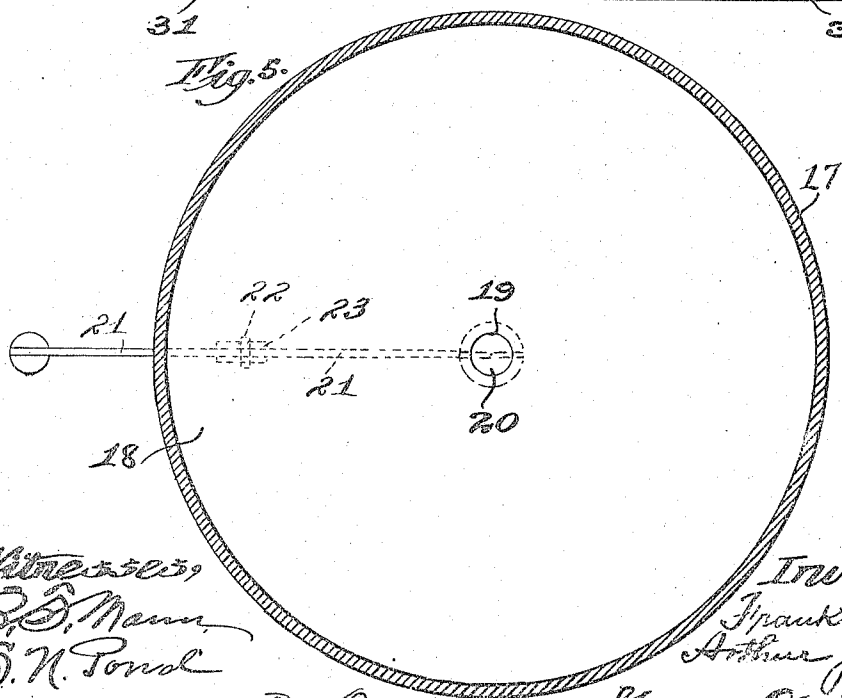


Fig. 5.



Witnesses,
P. S. Mann
S. N. Towle

Inventors,
Frank K. Hoover.
Arthur J. Mason.

By Offield, Towle, Graves & Offield

UNITED STATES PATENT OFFICE.

FRANK K. HOOVER AND ARTHUR J. MASON, OF CHICAGO, ILLINOIS.

HYDRAULIC SEPARATOR.

1,128,875. Specification of Letters Patent. Patented Feb. 16, 1915.

Application filed June 9, 1911. Serial No. 632,237.

To all whom it may concern:

Be it known that we, FRANK K. HOOVER and ARTHUR J. MASON, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Hydraulic Separators, of which the following is a specification.

This invention relates to the general art of separators, and pertains more especially to a device for separating out through the agency of water, clay, iron, sand and other foreign matter from mineral matter, such as phosphate of lime or "brown rock" which it is desired to obtain in a comparatively pure state.

The subject matter of the present invention is one of a group of devices which we employ in carrying out a novel process of treating natural deposits of phosphate rock and like material to free the same from the contained clay and other foreign matter and raise the commercial grade thereof as compared with the material in its natural state, such process constituting the subject-matter of an application filed by us June 9 1911, Serial No. 632,234.

The separator of the present invention is of the hydraulic type and operates on the principle of extracting the bulk of the mineral to be saved by sedimentation in the face of an upwardly flowing current of water and carrying off the impurities by overflow. The device is intended to take the material as it is delivered from a mixing and washing device or dasher in which the clay, through a process of tumbling the material in an abundant supply of water, has been brought into suspension; and in its complete and perfected form as herein shown, it comprises essentially a pair of receptacles, one superposed upon the other, through which the material passes, the upper of said receptacles effecting a rough rejection of the clay, and the lower effecting the rinsing and thorough cleaning of the mineral, the latter being extracted from the bottom of the lower receptacle, and the clay in suspension passing off by overflow from the upper surface of each receptacle.

In the upper of the two receptacles the greater portion—about seven-eighths—of the clay in suspension passes off with the liquid overflow. In the lower receptacle the solid matter received from the upper receptacle is subjected to a rinsing operation by an upwardly flowing current of clean, fresh water introduced under pressure at the lower portion of the receptacle.

The device of the invention, its principle of operation, and the benefits and advantages secured thereby, will be clearly understood when considered in connection with the accompanying drawings, which illustrate one practical mechanical form in which the invention may be embodied, and in which—

Figure 1 is a central vertical section through a complete separator. Fig. 2 is a top plan view thereof. Figs. 3, 4, and 5 are horizontal sections on the lines 3—3, 4—4, and 5—5, respectively, of Fig. 1.

Referring to the drawings, 10 designates the holder or container of the upper receptacle, taking the form of an inverted cone supported on a suitable annular frame member 11 and having at its lower end a discharge aperture 12 controlled by a ball valve 13 carried by an arm 14, which latter is pivoted at 15 to lugs 16 secured to the inner surface of the cylindrical wall of the lower receptacle 17. This latter, as herein shown, is a plain upright cylindrical vessel open at its upper end and having a flat bottom wall 18 provided with a central discharge aperture 19 likewise controlled by a ball valve 20 carried on the free end of a weighted lever 21 pivoted at 22 to lugs 23 on the bottom of the vessel 17.

Across the top of the cone-shaped vessel 10 is laid a series of parallel closely assembled channels 24 so disposed that their upper edges are slightly below the upper edge or rim of the vessel itself; and across the tops of these channels are laid a pair of bars 25 supporting a centrally apertured plate 26 in which is set a funnel 27 which receives the material to be treated from the discharge end of the dasher (not shown) through a delivery chute 28 and delivers it centrally to the vessel 10. Across and beneath the outer ends of the channels 24 are set receiving troughs 29 from which the overflow may be conducted to a suitable point of waste delivery or, preferably, into an auxiliary device for saving fine particles of mineral matter passing off in suspension with the water.

Across the open upper end of the lower vessel 17 is laid a similar series of channels 30 with their upper edges slightly below the upper edge or rim of the vessel, said chan-

nels being adapted to deliver the liquid at their ends into underlying transverse troughs 31. The upper troughs 29 are preferably arranged to deliver into the lower troughs 31 by means of down flow pipes 32 or equivalent connections.

To effect the distribution or dispersion of the solid matter delivered from the upper receptacle 10 into the lower receptacle 17 throughout substantially the entire cross-sectional area of the latter we utilize the spherical ball valve 13, which is so formed as to act as a distributer. Toward the bottom of the tank 17 is a pipe 36 arranged for the delivery of clean water entering through a supply pipe 37 passed through the side wall of the tank.

For the purpose of controlling the upwardly flowing stream of clean water entering through pipe 36, and causing it to mingle with the downwardly passing material, we provide an annular zigzag chamber formed by and between outer and inner corrugated walls 34 and 35, whereby there is formed an annular passage for both the rising and descending streams; the material having a specific gravity of more than twice that of water passing downward, and the stream of water under pressure from pipe 36 passing upward.

When the ball valve 13 is opened, the material lying in the lower portion of the cone 10 influenced by a head of about four feet rushes through the opening, the specific form of the valve causing it to scatter in the manner indicated. It then proceeds downward crossing the upflowing water with each corrugation of the annular passage way, until it lodges in the lower portion of the tank 17.

The ball valves 13 and 20 may be manually operated, but are preferably both actuated in suitably timed order through some intermittently operating valve-actuating mechanism; such a mechanism being indicated in connection with Fig. 1 and consisting of a cam 51 on a rotary shaft 52, acting once at each revolution to raise a pivoted arm 53, to which latter are connected by cords 54 and 55, weighted levers 56 and 21, the former being connected by a cord 58 to the arm 14 which carries the ball valve, 13, while the latter itself carries the ball valve 20; the arrangement being such that the weighted levers 56 and 21 normally hold the ball valves closed, while the engagement of the cam 51 with the arm 53, which may occur six to eight times a minute, allows said valves to slowly open, the counter-weights rapidly closing them as the abrupt side of the cam 51 passes off the free end of arm 53. Under this plan we find that the solid material treated is accompanied at the points of discharge through the ball valve by about an equal weight of water; the loss of this amount of water not being sufficient to materially disturb the overflow at channels 24 and 30. The emission of material through the discharge openings 12 and 19 is vigorous and in itself causes a considerable rubbing and cleaning action in the presence of abundant water.

Both of the receptacles 10 and 17 are normally maintained in a brimful condition, so that the addition of any material causes an overflow to take place over the edges of the channels, which latter form in effect a series of overflow dams. This overflowing body of liquid carries with it in suspension the greater part of the clay and foreign matter, and also some finer particles of phosphate rock or other mineral being treated, that is particles ranging from a maximum diameter of one one-hundredth of an inch to impalpable powder.

As the material delivered by trough 28 needs further dilution in its early stages, we introduce an additional supply of water through a pipe 37^a, delivering into the upper end of the funnel 27 and meeting and commingling with the material delivered by trough 28. A diaphragm 50 is preferably secured slightly below the lower end of the funnel 27 for the purpose of dispersing the material to be treated throughout the cross-sectional area of the receptacle 10. An additional supply of clean water is introduced to the receptacle 10 through a pipe 37^b entering the side of the latter, the function of this stream being to render clean the deposit of rock in the bottom of the cone, the effect being that this clean water displaces the muddy water existing throughout the upper portion of the cone.

Referring again to the action taking place within the tank 17, it will be manifest that as the direction and movement of the descending particles is opposed by the upward movement of the water, the latter and the particles of material crossing each other's path at every bend of the zigzag annular channel, a very thorough rinsing and cleaning of the mineral matter takes place. Where an abundant supply of water is available, the upper receptacle 10 may be dispensed with, and the material from the washer delivered directly into the upper end of the tank 17. In effecting the delivery of the solid matter from both the upper and lower tanks, only a part of the accumulated solid matter is withdrawn at a time, as above explained, in order to limit the escape of water at these points as much as possible. The cleansed mineral matter delivered from the tank 17 is, in accordance with our improved process of treating phosphate rock, subsequently drained and then dried; while the overflow from both tanks is further treated to separate out and save the fine particles of mineral matter. With these subsequent operations, however, the

device of the present invention is not concerned.

We claim:

1. In a separator for the purpose described, the combination with an upper receptacle provided with an overflow for the water and matter suspended therein, and with an opening at its lower end for the discharge of the solid matter, of a lower receptacle receiving the solid matter from the upper receptacle, a valve located beneath the water level in said lower receptacle beneath and controlling said opening having a convex upper surface adapted, when the valve is opened, to deflect said solid matter toward the sides of said lower receptacle, means for introducing water under pressure into the lower portion of said lower receptacle, and means within said lower receptacle for causing the descending solid matter to fall through an ascending current of water.

2. In a separator for the purpose described, the combination with an upper receptacle provided with an overflow for the water and matter suspended therein, and with an opening at its lower end for the discharge of the solid matter, of a lower receptacle receiving the solid matter from said upper receptacle, a valve located beneath the water level in said lower receptacle movable toward and from said opening, means for intermittently opening and closing said valve, means for introducing water under pressure into the lower portion of said lower receptacle, means within said lower receptacle for causing the descending solid matter and the ascending water to intercept each other's paths, and means for effecting a uniformly distributed overflow of said water from the top of said lower receptacle.

3. In a separator for the purpose described, the combination with an upper receptacle of inverted cone shape provided with an overflow for the water and matter suspended therein, and with an opening at its apex or lower end for the discharge of the solid matter, of a lower receptacle receiving the solid matter from the upper receptacle, a valve beneath and controlling said opening having a rounded upper surface adapted to disperse said solid matter throughout the cross-sectional area of said lower receptacle and located beneath the water level in said lower receptacle, means for intermittently opening and closing said valve, means for introducing clean water under pressure into the lower portion of said lower receptacle, and means for effecting a uniformly distributed overflow of said water from the top of said lower receptacle, whereby the descending solid matter and the ascending water intercept and pass each other while flowing in opposite directions through said lower receptacle.

4. In a separator for the purpose described, the combination of superposed upper and lower washing receptacles, both of said receptacles having overflow devices at their upper ends for the discharge of water carrying suspended foreign matter, and openings at their lower ends for the discharge of solid matter, the upper receptacle being adapted to discharge into the lower receptacle and beneath the water level thereof, valves adapted to open and close said discharge openings, the valve of the upper receptacle being located below the liquid level of the lower receptacle and being adapted to spread the material in said lower receptacle, and means for intermittently opening and closing said valves.

FRANK K. HOOVER.
ARTHUR J. MASON.

Witnesses:
SAMUEL N. POND,
C. A. KENYON.