July 10, 1951 P. J. GRESHAM 2,559,917

CENTRIFUGE BOWL WITH RECIPROCATING VALVE FOR DISCHARGING SOLIDS FROM THE BOWL

Filed Dec. 22, 1945 3 Sheets-Sheet 1

Fig. 7

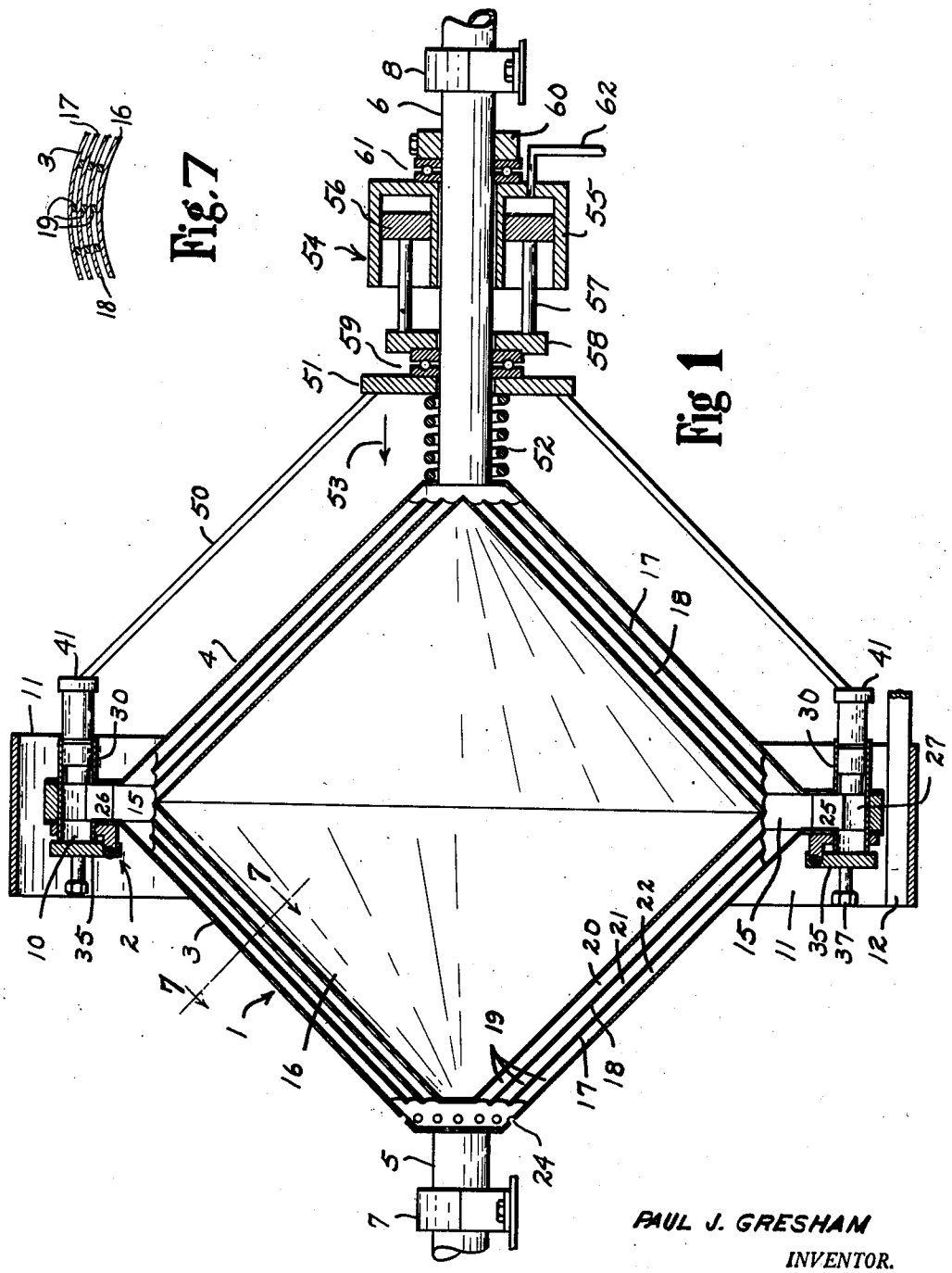


Fig 1

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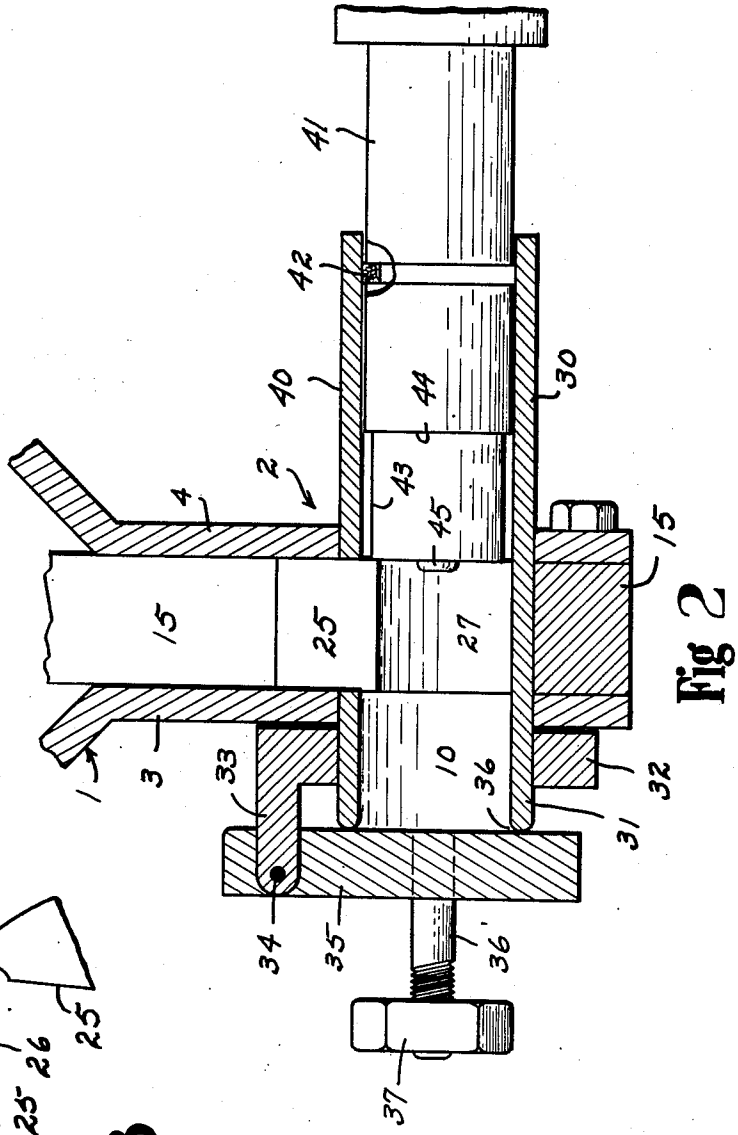


Fig 2

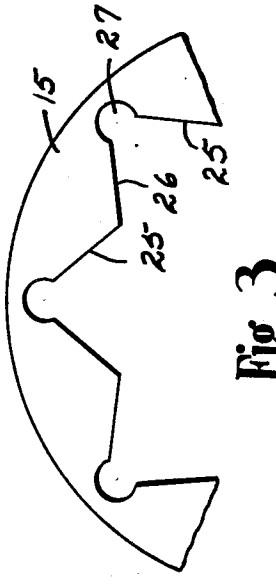


Fig 3

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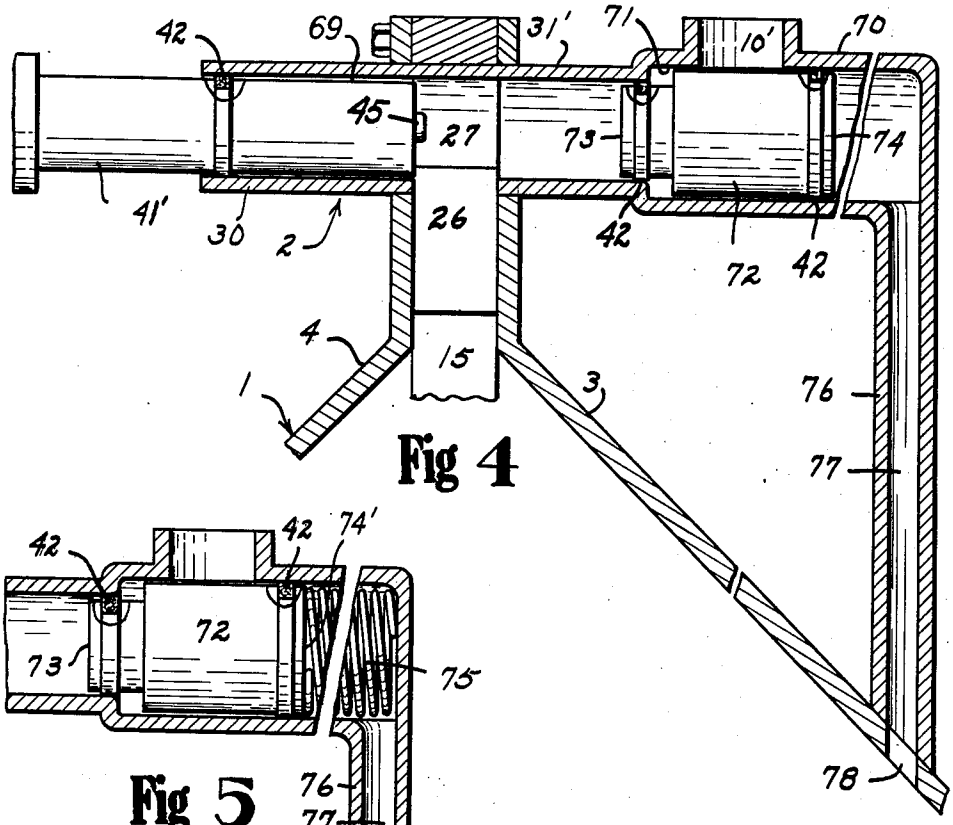


Fig 4

Fig 5

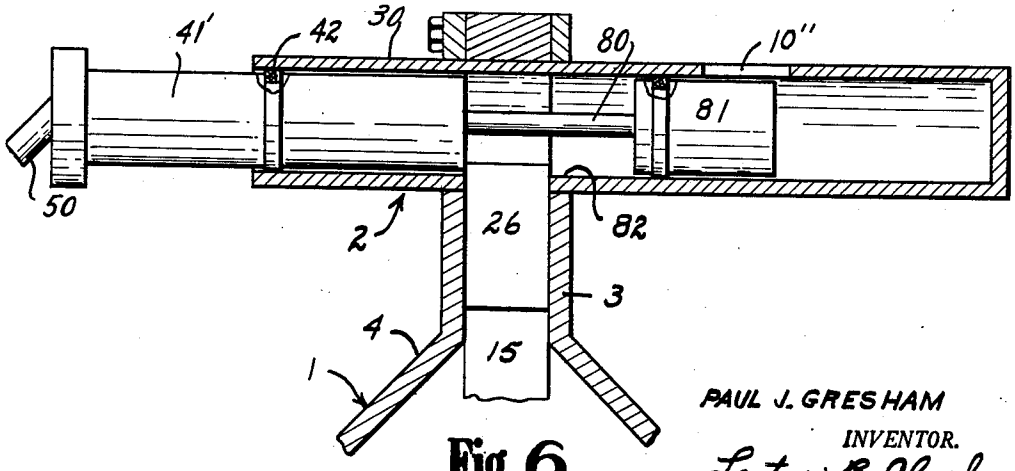


Fig 6

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CENTRIFUGE BOWL WITH RECIPROCATING VALVE FOR DISCHARGING SOLIDS FROM THE BOWL

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Application December 22, 1945, Serial No. 636,779

3 Claims. (Cl. 233—20)

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This invention relates to the separation of solids from liquids, and is of particular utility for handling a large volume of solids-in-liquid influent, such for example as encountered in sewage disposal, and effectively separating the solids from the liquid thereof.

The invention relates and broadly comprehends the subject matter of my co-pending application, Serial Number 593,274, filed May 11, 1945, now abandoned, and constitutes an improvement of the invention disclosed therein.

The primary object of the invention is to provide improved means for removing, from within the centrifuge chamber, solids which are progressively segregated and accumulated under the action of centrifugal force exerted during the normal operation of the centrifuge.

Another object is to provide a piston type of mechanism adapted to be actuated at intervals to effect expulsion of accumulated solids from within the centrifuge chamber.

Still another object is to provide means normally closing the outlet port for solids, but operable upon movement of the discharge piston to open such port.

Another and more specific object is to provide a centrifuge chamber having solids receiving pockets on its inner periphery, and a passage transversely thereof together with a piston movable within such passage to remove accumulated solids from within the passage.

A still further object is to provide a discharge passage and a piston cooperating therewith, such elements being so constructed and arranged that solids only are discharged when the piston is actuated.

The invention also comprehends the use of piston actuating means operable at predetermined intervals for moving a plurality of pistons to exhaust solids peripherally of the device.

The foregoing objects are primary objects, which, together with other objects and advantages of the invention, will be more fully apparent from the following description considered in connection with the accompanying drawings in which:

Fig. 1 is a vertical sectional view through one form of the device embodying the invention;

Fig. 2 is an enlarged detail in section through one of the discharge assemblies;

Fig. 3 is a detail view of a portion of the pocketed annulus forming an element of the invention;

Fig. 4 is a detail view in section showing a modified form of the solids discharge mechanism,

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such form utilizing fluid pressure to close the discharge port;

Fig. 5 is a view similar to that shown in Fig. 4, but showing the use of a supplemental spring pressure to maintain the solids discharge port closed;

Fig. 6 is a sectional view of one form of discharge assembly which includes synchronously movable pistons for moving segregated solids to the discharge port;

Fig. 7 is a sectional view taken one line 7—7 in Fig. 1.

One form of the invention is shown in Fig. 1 as a centrifuge 1 comprising a discharge assembly 2 secured to conical housing members 3 and 4 to which the shafts 5 and 6 are attached, the entire centrifuge being mounted upon bearings 7 and 8. The shaft 6 is tubular to provide an inlet to the interior of the centrifuge 1 as will be more fully described. A suitable source of power (not shown) is operably connected to one of the shafts 5 or 6 to impart adequate rotational speed to the centrifuge to effect centrifugal separation of the solids from the liquids of the influent introduced to the chamber within the housing 1.

It is intended that segregated solids will be discharged from the ports 10 of the assembly 2, during rotation of the centrifuge and in a manner to be more fully described, and that such solids will be thrown by centrifugal force outwardly against the collector ring 11 which is rotated slowly by means of a suitable source of power (not shown). A scraper blade 12 extends transversely of the ring 11 proximate its lowermost portion and serves to remove the solids from upon the inner periphery of the member 11.

The discharge assembly 2 includes the annulus 15 to which are attached the peripheral edges of the conical members 3 and 4 of the housing 1. The opposite ends of these members are in turn secured to the shafts 5 and 6.

Interiorly of the chamber, formed by the elements to which reference has just been made, is a hollow body 16 of a symmetrical configuration and complementary with the interior of the housing 1. Interposed between such body and the outer wall of the centrifuge are a plurality of parallel conical guiding walls shown at 17 and 18, there being a plurality of spacer fins or vanes 19 interposed and secured to the successive members so that there are provided a plurality of radially extending passages 20, 21 and 22. This construction requires that the fluids introduced to the device move radially thereof while

spread into thin sheets, and the fins 19 in the respective passages prevent peripheral slip between the centrifuge and the material passing therethrough. The structure therefore enhances the application of centrifugal force to effect desired separation of the solids from the liquids of the influent introduced through the shaft 6.

The inner periphery of the annulus 15 has oppositely tapering surfaces 25 and 26 (Fig. 3) which terminate at their outermost ends in cylindrical pockets 27 which, as clearly shown in Fig. 2, are in alignment with the bore of the transverse cylinder 30 which has its opposite ends extending sidewardly from the annulus. The end 31 of the cylinder 30 comprises the discharge port 10 and has provided thereon a support member 32 with the ear 33 thereon for a pivotal connection 34 with the valve or closure member 35 engageable with the outer end 36 of the cylinder to form a closure therefor. The pivot 34 is located radially inward of the port 10 and hence the valve 35 tends to remain normally closed from centrifugal force exerted thereon. To enhance this tendency and hence assure positive closure of the valve 35 upon the seating surface 36, there is provided a stud 36' in the valve member and such stud is provided with a weight 37 thereon. It seems apparent that centrifugal force acting upon the weight 37 greatly increases the force which holds the valve upon its seat, and hence closure of the discharge port 10 is maintained except when discharge of solids therefrom is effected as hereinafter described.

The opposite end 40 of the cylinder 30 has a piston 41 slidably fitting therein. A seal ring 42 of a suitable type forms a seal with the inner wall of the cylinder 30 whereby leakage of fluids past the piston is prevented.

It is intended, as will more fully appear in the description of the operation of the device of the invention, that each of the pistons 41 shall be moved axially of the cylinder 30 toward the discharge port 10. Such movement causes the inner end of the piston to traverse the respective pockets 27 in the annulus 15 and hence any solids collected in a given pocket and the adjacent discharge port will be moved by the piston into a compact mass within the port. Continued movement of the piston 41 will cause the valve member 35 to open whereby the extruded solids will discharge radially under centrifugal force to the interior of the ring 11 for disposition in the manner already explained.

Attention is directed to the fact that the inner end of the piston 41 is reduced in diameter at 43 whereby a shoulder 44 is formed thereon. The reduced portion 43 enters the discharge port 10 with a slight clearance whereby any liquid or semi-liquid within the discharge port will move toward the interior of the centrifuge chamber as the piston advances. On the other hand, the solids are advanced by the piston and will, when sufficient force is applied, open the valve 35 whereby the solids are progressively discharged. The shoulder 44 on the piston enters the discharge port 10 just before the solids are completely discharged, and in this manner a closure is formed that prevents leakage of liquids past the piston and through the port 10 at the instant all solids are removed therefrom under centrifugal force. As the piston moves to terminal position an abutment 45 thereon engages the valve 35 so that all solids are free to move outwardly under centrifugal force while the valve is held open.

The pistons 41 in the discharge assembly 2 may be operated in any desired sequence, or simultaneously. In any event operation should be such as to minimize the possibility of creating a condition of eccentricity within the centrifuge. Preferably, as shown in Fig. 1, a spider 50 is attached to the pistons 41 while the opposite end of such spider is attached to a thrust ring 51 engaged by the compression spring 52 surrounding the shaft 6 and normally urging the spider outwardly to hold the pistons 41 in their outermost position as shown in Figs. 1 and 2.

It seems apparent that when the spider 50 is moved against the tension of the spring 52, as indicated by the arrow 53, discharge of solids from the respective cylinders 30 is initiated. To effect this movement there is provided a pneumatically or hydraulically actuated mechanism generally referred to as 54, and comprising a stationary annular cylinder 55 having an annular piston 56 therein. This piston is attached through studs 57 to a disk 58, there being a thrust bearing 59 interposed between such disk and the thrust ring 51.

Interposed between the base of the cylinder 55 and a collar 60 on the shaft 6, is the thrust bearing 61, it being apparent that the bearings 59 and 61 permit the assembly 54 to remain stationary while the remainder of the device is rotated.

Pressure fluid is admitted to the cylinder 55 and beneath the piston 56 through the pipe 62 connected to a suitable source of pressure fluid. It is to be understood that the actuation of this mechanism can be effected at any desired sequence of intervals either manually or automatically.

The operation of the device is believed apparent from the foregoing description of an illustrative embodiment of the invention. By way of summary and supplementation, it will be assumed that all parts are in the relative positions shown in Fig. 1. A solids-in-liquid influent is introduced through the shaft 6 while the entire centrifuge is rotated at a desired speed. The influent enters the centrifuge chamber and moves in thin sheets along the plurality of paths defined by the body 16, the centrifuge housing 1, the interposed dividing walls 17 and 18, and the interconnecting fins 19. Energy is imparted to the moving material as it moves outwardly toward the discharge assembly 2 and at the same time the separation of solids from the liquids takes place progressively, the solids tending to move along the outer surfaces of the respective passages and thence discharging upon the surfaces 25 and 26 of the annulus 15. These solids then move into the pockets 27.

At intervals the pistons 41 are moved toward the discharge ports 10 whereby accumulated solids within the pockets 27 and the discharge ports are extruded as the respective valves 35 are opened. The solids thus discharged accumulate upon the inner periphery of the ring 11 which, as already explained, is rotated slowly so that the scraper 12 removes such solids for desired disposition.

While, as above indicated, rotational energy is imparted to the material moving outwardly toward the discharge assembly 2, a major portion of such energy is returned to the rotating system as the fluids move inwardly from the assembly 2 toward the fluids discharge openings 24 proximate the axis of rotation. It is thus apparent that energy losses are confined to fric-

tion and windage and the kinetic energy of the solids discharged from the assembly 2 and of the liquids discharged from the openings 24. Suitable collector means for the exhausted liquid (not shown) will of course be provided to conduct the effluent from the device.

A modified form of the discharge assembly is shown in Fig. 4 and like parts thereof are identified by like reference characters. In this construction, however, the end 31' is provided with a continuation 76 having an enlarged bore 71 within which the differential piston 72 is movable. This piston has an inner face 73 which is of smaller areal extent than the outer face 74, it being intended that the piston shall normally assume the position indicated in the drawings whereby the discharge port 10' is maintained closed. Fluid pressure is exerted upon the face 74 through the connection 76 of which the passage 76 communicates through the opening 78 to the interior of the chamber 1. By means of this construction, centrifugal force acting upon the face 74 is greater than the force acting upon the face 73 whereby the valve is normally maintained in closed position.

The piston 41' in this form of the invention is shown as having a clearance at 69 to permit extrusion of liquid or semi-liquid from within the passage before the valve 72 opens, alternately of course, the stepped piston 41 of Fig. 2 may be used. In any event, movement of the piston 41' toward the differential piston 72 will impact accumulated solids which will in turn force the piston 72 outwardly or to the right so that such solids will move under centrifugal force to and through the discharge port 10'.

The embodiment shown in Fig. 5 is similar to that just described, but the centrifugal force of fluid acting upon the face 74' of the piston 72 is supplemented by the compression spring 75 which is interposed between the piston and the outer end of the passage within which the piston moves.

In the embodiment of Fig. 6 the piston 41' has a stem 80 thereon. This stem is attached to the piston 81 which forms a closure for the discharge port 10''. As the piston assembly moves inwardly, accumulated solids are moved therewith and such solids are thrown outwardly by centrifugal force and through the discharge port 10'' when such port is uncovered by movement of the assembly. At the same time however, the inner end of the piston 41' enters the bore 82 so that a closure is formed to prevent the leakage of fluid during the interval of discharge of solids from the port 10''.

While the foregoing description has referred to specific structures embodying the invention and has referred to the specific use of the device for sewage treatment, it is intended that such references are by way of illustration only and not of limitation.

Broadly the invention comprehends new and useful improvements in a centrifuge, and particularly mechanisms for removing solids from within the centrifuge chamber during continued operation thereof whereby the solids are effectively removed from a solids-in-liquid influent.

The invention claimed is:

1. A centrifugal separator comprising a centrifuge chamber having peripheral intersecting radial and transverse passages forming a plurality of solids receiving spaces therein, each of said passages extending from the interior of the chamber to the exterior of the chamber, means normally closing one end of each transverse passage at its outer end, a piston in each transverse passage opposite said closure means, a reduced end portion on said piston and means for moving the piston toward said first mentioned means whereby the solids are impacted therebetween and the closure means opened to exhaust solids from within the passage.

2. A centrifugal separator comprising, a centrifuge body having intersecting radial and transverse passages in its periphery for the discharge of solids accumulated in the transverse passage, a piston in one end of said passage, there being a discharge port in the other end of the passage, closure means movable under centrifugal force to normally close said discharge port, a stepped end on said piston to enter the passage to entrap solids proximate said closure means and to thereafter open said means and discharge the entrapped solids, said stepped portion being of a length that the larger portion of the piston closes the radial passage as the end of the piston approaches the closure means.

3. A centrifugal separator comprising a chamber having a radial passage and a transverse passage at the outer end thereof forming a passage between the interior and the exterior of the chamber, means normally closing one end of the transverse passage, a stepped piston in the transverse passage opposite said means, and means for moving the piston toward said closure to impact solids within the transverse passage and to thereafter close the passage inwardly of the outer end and then move the closure means to open position whereby the impacted solids are exhausted from the passage.

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