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SOLIDS DISCHARGE CENTRIFUGE

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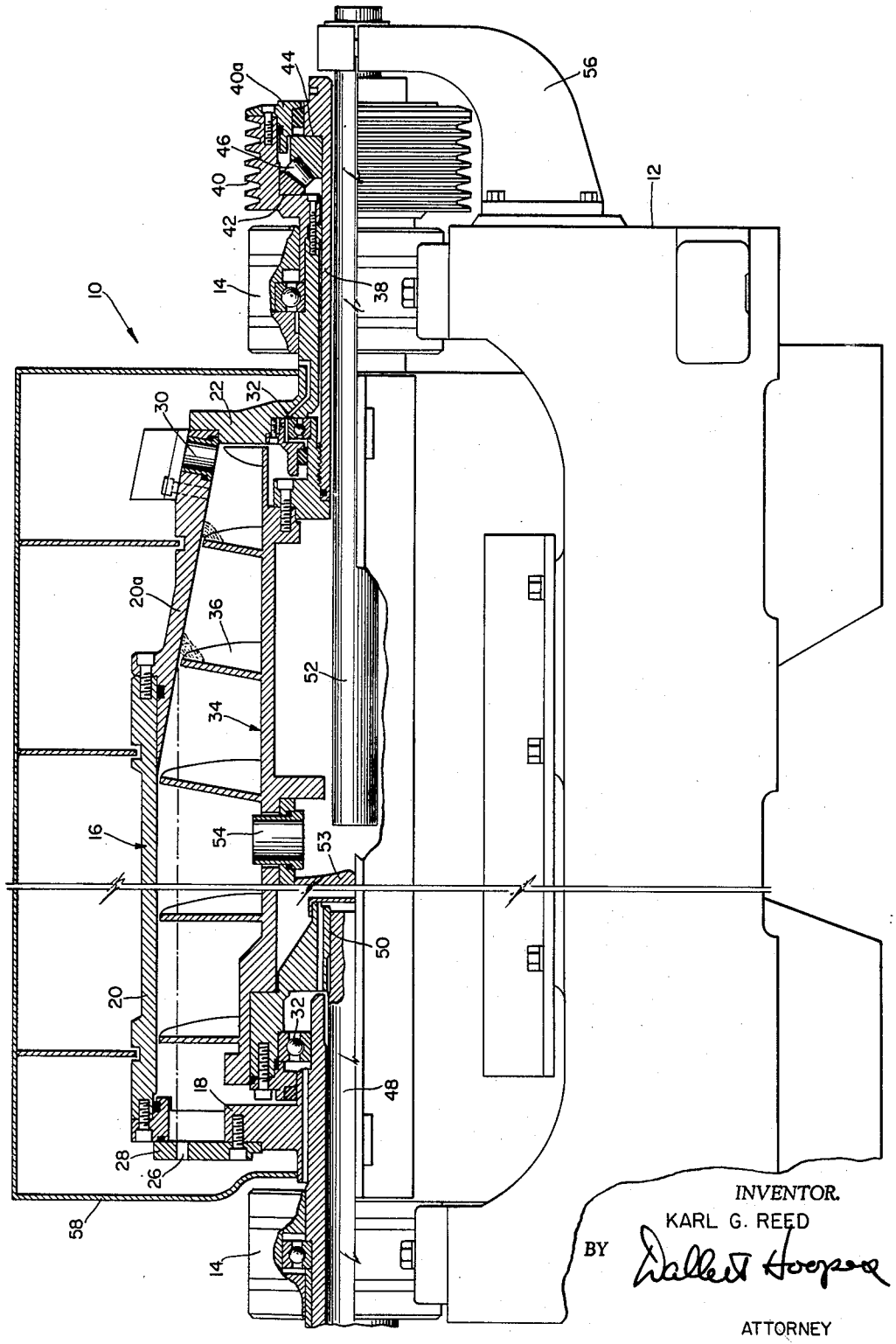

INVENTOR.
KARL G. REED
BY Wallace Hoopes
ATTORNEY

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SOLIDS DISCHARGE CENTRIFUGE

Karl G. Reed, Wayne, Pa., assignor to Pennsalt Chemicals Corporation, a corporation of Pennsylvania

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This invention relates to a centrifuge. More specifically this invention relates to a centrifuge containing an axially disposed conveyor element rotating at a speed different from that of the centrifuge bowl and serving to move solids toward the solids discharge port.

In the centrifugal separation of solids from a liquid it has been quite common to provide a centrifuge bowl with a solids discharge port inward from the liquid discharge port and an axially disposed conveyor element usually in the form of a helical edge which rotates at a speed different from that of the centrifuge bowl to move the solids inward out of the liquid in the bowl to the solids discharge port for discharge. As the solids are moved inward out of the liquid and toward the discharge they drain on an inwardly tapered wall portion and become comparatively dry as they reach the discharge port. An example of a machine operating in this manner is disclosed in the U.S. Patent 2,703,676, which issued March 8, 1955, on an application filed by Fred P. Gooch.

In moving the solids inward out of the liquid and toward the solids discharge port a thrust caused by the resistance to movement of the solids urges the conveyor in a direction away from the solids discharge port. In the prior art machines this thrust has conventionally been borne by a thrust bearing disposed between the conveyor and the end wall of the centrifuge opposite the solids discharge port. This end wall, or front hub, has been, especially in large machines, of necessity, massive to withstand the lateral urging on the periphery of the hub by the bowl shell without bending. Further, extremely rugged connecting means, e.g. bowl shell flanges and many flange bolts, have been required to hold the hub and peripheral wall together. The rugged and massive nature of these parts has been dictated not only by the thrust forces but also by the internal liquid pressure present in the bowl at the juncture of the hub and bowl shell. This heavy structure has increased the power required to accelerate the centrifuge, has increased the expense of construction and has complicated balancing procedures.

In addition to the disadvantages of high strength structures, the location of the thrust bearing elements within the centrifuge has made them inaccessible for easy inspection, repair and replacement. For instance, to merely inspect the thrust bearing in the prior art machines it has been necessary to remove the rotor from its frame, and remove the front hub with the gear box and shaft from the bowl shell. Such procedure has not only consumed excessive time of the repairman and operator, but, more importantly, has had a major effect on the amount of lost production time.

It is, therefore, an object of the present invention to provide a centrifuge of the type described in which the reaction forces generated by the scrolling of solids toward the solids discharge port is in a compressive form borne at the juncture of the bowl shell and the rear hub, or end wall of the machine adjacent the solids discharge port. Since the diameters of the parts at the solids discharge portion of the bowl are significantly less than at the front

hub where the forces have previously been borne, the connecting portions, that is the flanges and flange bolts, need not be significantly strengthened. This is especially true in comparison with the juncture of the front hub and bowl shell of the old design, since under the present invention the juncture of the bowl shell and rear hub is inward of the liquid in the bowl and is not subject to liquid pressures.

It is a further object of the invention to provide in the centrifuge of the type described for the easy accessibility of the thrust bearing from the outside of the centrifuge.

Other features and objects of the invention will be apparent from the following description of an apparatus embodying the invention and shown in the accompanying drawings wherein the figure is a broken sectional view, partly in elevation, of an apparatus embodying the invention, the liquid level and separated solids being shown in phantom.

Referring more specifically to the drawings, a centrifuge embodying the invention is designated **10** in the figure. It comprises a frame **12** supporting a pair of pillow block bearings **14**. Mounted for rotation in the bearings is the rotor or centrifuge bowl **16** comprising a front hub **18** secured at a peripheral flange to the bowl shell **20**. At the opposite end the rotor comprises the rear hub or wall **22**. A tapered wall portion **20***a* comprises part of the bowl shell and is secured at its end to the rear hub.

A liquid discharge port **26** is provided in a plate dam **28** secured in the front hub **18**. A solids discharge port **30** having the outermost edge of its inner lip disposed inwardly of the outermost margin of the liquid discharge port **26** is disposed adjacent the rear hub **22** in the tapered wall portion **20***a*.

Rotatably mounted on bearings **32** within the rotor **16** is the conveyor **34**. The body of the conveyor **34** is formed with outwardly extending flight portions **36**, the edges of which are disposed closely adjacent the inside surface of the rotor shell. Threadedly secured to the rightward end of the conveyor **34** as shown in the figure is the tension element **38** extending in a central hollow portion of the rotor within the rightward bearing **14**. As shown, on the side opposite the rightward bearing **14** from the centrifuge bowl the rotor is provided with a pulley means **40** by which the rotor may be driven. Internally the pulley means **40** is formed with a radial shoulder **42** and the tension element **38** is formed with an enlargement presenting a radial shoulder **44** opposing shoulder **42**. Intermediate the shoulders **42** and **44** is disposed in compression the thrust bearing means **46** comprising in the embodiment shown a roller bearing. The seal **40***a* closes the compartment defined by the pulley means.

As in prior art devices, such as the device of the above-mentioned patent, the rotor shaft extending through the leftward bearing **14** is secured to an appropriate gear box (not shown) containing a suitable gear train by which rotary motion is transmitted at the desired differential to the conveyor shaft **48** which is splined at **50** to drive the conveyor.

The feed tube **52** extends through the tension element **38** and is adapted to deliver feed mixture against the accelerator plate **53** and through the feed port **54** in the conveyor body. At its rightward end the feed tube **52** is supported by a bracket **56**. A cover **58** is secured to the

frame 12 and collects the separated discharges as is conventional.

In operation with the rotor 16 rotating at an appropriate speed, for instance 4000 r.p.m., and the conveyor driven through the gear box at a suitable differential, the liquid solids mixture is delivered to the rotor through the feed tube 52 and the feed port 54. Under the influence of centrifugal force the heavier solids settle in the liquid to form a layer against the bowl shell 20. The clarified liquid passes out the liquid discharge port 26 and thereby establishes the level of liquid in the rotor at the level of the port. The solids are moved by the edges of flights in a rightward direction inward out of the liquid to the solids discharge port 30. In so moving to and out of the port the solids become dry as they drain on the tapered wall portion 20*a*. By being thus concentrated and dried the solids increase in their resistance to inward movement by the conveyor flights and as a reaction to the force applied against them the solids urge the entire conveyor in a leftward direction as shown in the figure. The leftward urging creates a tension in the element 38 and a compressive force on the bearing means 46. The compression force is carried through the rotor shaft within the rightward bearing 14 and through the juncture of the tapered wall portion 20*a* and the rear hub 22.

Unlike the prior art forms in which the thrust of the conveyor acted against the front hub and required massive flanges and many connectors between the front hub and the bowl shell, under the present arrangement the compressive force is easily absorbed at the juncture of the tapered wall portion 20*a* and the rear hub 22. This is especially true since unlike the prior forms, at this juncture there is no liquid pressure. Hence the power required to accelerate the present machine and the amount of metal required to build it and hence the expense are significantly less than in prior comparable structures. Further, by having the bearing means 46 outside of the centrifuge it is readily accessible to inspection, repair or replacement. As will be understood, to inspect the bearing means 46 it is merely necessary to remove the feed tube 52, the tension element 38 and the pulley seal 40*a*.

Variations of the apparatus shown are possible within the scope of the appended claims. Hence while I have explained my invention with the aid of a particular embodiment thereof, it is to be understood that I do not wish to be limited to the specific structural details illustrated and described from which departure can be made without departing from the spirit and scope of the invention as defined by the following claims.

I claim:

1. A centrifuge comprising:

(*a*) a rotor mounted to rotate about a horizontal axis and having a pair of end walls and an imperforate peripheral shell with a portion tapering inwardly toward one end, the shell being secured between the end walls, the rotor having a solids discharge port at the said end, the end wall at the said end having a central opening, the other end of the rotor having a liquid discharge port inward from the shell but at a radius greater than the solids discharge port, the said end wall and the shell meeting at an inner juncture, the inner juncture being radially inward from the liquid discharge port, the other end wall and the shell meeting at an outer juncture, the outer juncture being radially outward from the liquid discharge port,

(*b*) a conveyor rotatably supported within the rotor, the conveyor having a body portion and a helical edge portion supported by the body portion, the helical edge portion being closely adjacent the shell and adapted in rotating to move solids toward the solids discharge port,

(*c*) a tension element removably secured to the conveyor and extending through the central opening in the said one end wall,

(*d*) means to supply feed mixture to the interior of the rotor,

(*e*) means to drive the rotor and the conveyor at different speeds including a drive shaft on the rotor and surrounding the tension element and presenting a shoulder facing away from the rotor,

(*f*) enlarged means on the tension element on the opposite side of the shoulder from the rotor, the shoulder and the enlarged means being axially spaced and the enlarged means presenting a second shoulder generally facing the first-mentioned shoulder, and

(*g*) thrust bearing means having freely rolling elements and disposed in the space and held in axial compression between the shoulders,

whereby the forces developed between the conveyor and the rotor as the conveyor moves the solids toward the solids discharge port appear as a compressive force acting at the inner juncture instead of as a tension force at the outer juncture.

2. A centrifuge as described in claim 1 wherein the conveyor body portion has an axial threaded opening in its end adjacent the said end of the rotor, the tension element is tubular and threaded on one end and has an enlarged head on the other, the threaded end being threadedly received into the last-mentioned opening and the head comprising the enlarged means.

3. A centrifuge comprising:

(*a*) a rotor mounted to rotate about a horizontal axis and having a pair of end walls and an imperforate peripheral shell with a portion tapering inwardly toward one end, the shell being secured between the end walls, the rotor having a solids discharge port at the said end, the end wall at the said end having a central opening, the other end of the rotor having a liquid discharge port inward from the shell but at a radius greater than the solids discharge port, the said end wall and the shell meeting at an inner juncture, the inner juncture being radially inward from the liquid discharge port, the other end wall and the shell meeting at an outer juncture, the outer juncture being radially outward from the liquid discharge port,

(*b*) a conveyor rotatably supported within the rotor, the conveyor having a body portion and a helical edge portion supported by the body portion, the helical edge portion being closely adjacent the shell and adapted in rotating to move solids toward the solids discharge port,

(*c*) means to supply feed mixture to the interior of the rotor,

(*d*) means to drive the rotor and the conveyor at different speeds including a tubular drive shaft on the rotor and extending axially out from the said end about the central opening, and presenting a shoulder facing away from the rotor,

(*e*) thrust bearing means having freely rolling elements and having an inner face abutting about said shoulder and an outer face directed away from the rotor,

(*f*) force-conducting means extending through the opening in the said end wall and through the tubular drive shaft and including a threaded, readily disassemblable joint and connecting the conveyor and the outer face of the thrust bearing means so that axial thrust of the conveyor in a direction toward the said other end wall is borne by the thrust bearing means,

whereby the forces developed between the conveyor and the rotor as the conveyor moves the solids toward the solids discharge port appear as a compressive force acting at the inner juncture instead of as a tension force at the outer juncture.

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Disclaimer

3,148,145.—*Karl G. Reed*, Wayne, Pa. SOLIDS DISCHARGE CENTRIFUGE. Patent dated Sept. 8, 1964. Disclaimer filed Mar. 5, 1965, by the assignee, *Pennsalt Chemicals Corporation.*

Hereby enters this disclaimer to claim 3 of said patent.

[*Official Gazette June 15, 1965.*]

Disclaimer

3,148,145.—*Karl G. Reed*, Wayne, Pa. SOLIDS DISCHARGE CENTRIFUGE. Patent dated Sept. 8, 1964. Disclaimer filed June 9, 1965, by the assignee, *Pennsalt Chemicals Corporation.*

Hereby enters this disclaimer to claim 1 of said patent.

[*Official Gazette September 14, 1965.*]