Feb. 20, 1968 C. W. WEILAND 3,369,742

DISCHARGE VALVE FOR CENTRIFUGE

Filed Nov. 30, 1965 2 Sheets-Sheet 1

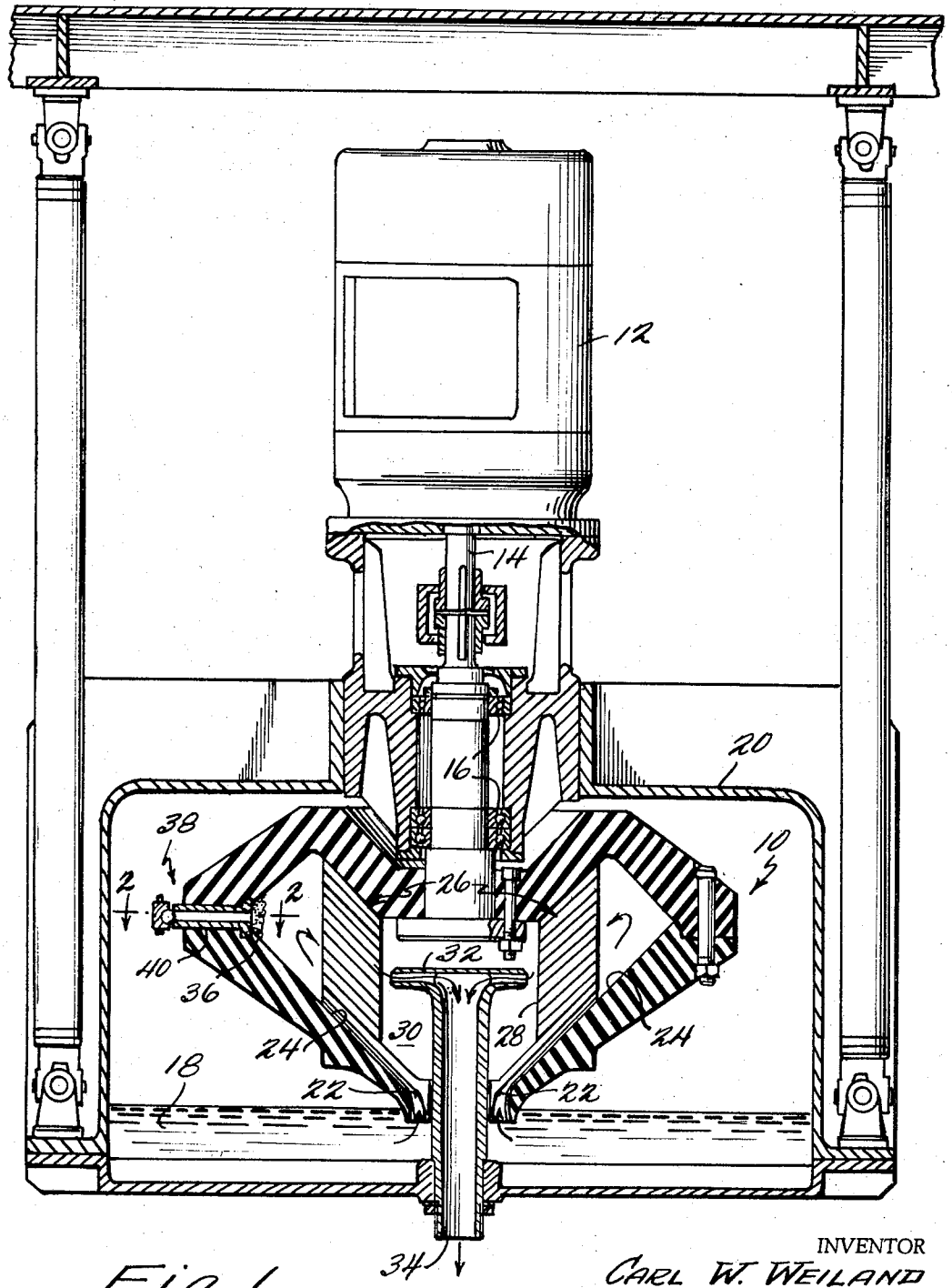


Fig. 1

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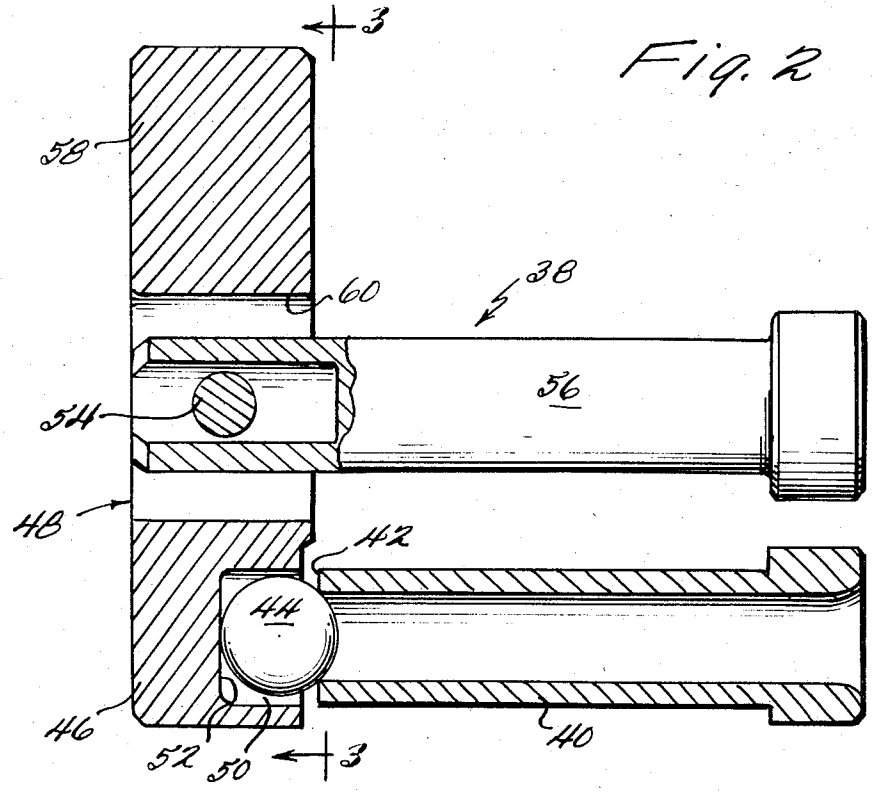


Fig. 2

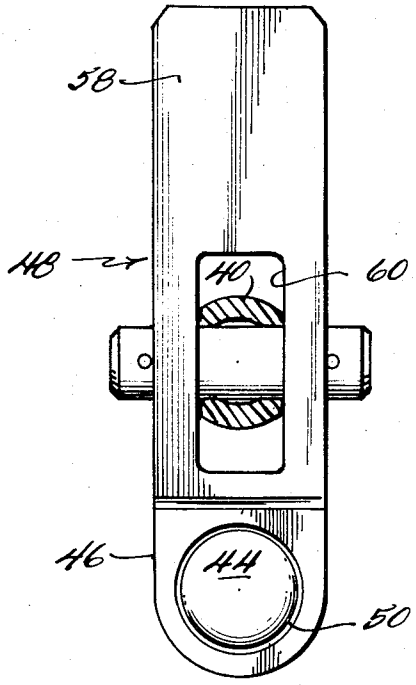


Fig. 3

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DISCHARGE VALVE FOR CENTRIFUGE

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ABSTRACT OF THE DISCLOSURE

An improved discharge valve is provided in a centrifuge, and the discharge valve includes a ball element which can open and close a discharge opening in a wall of the centrifuge. The ball element is loosely carried in a recess of a lever for opening and closing movements over the discharge opening, and the loosely carried ball element can position itself over the discharge opening for a tight sealing of the opening.

This invention relates to centrifuges, and particularly to a sludge discharge valve in a centrifuge apparatus for removing solid matter from a liquid coolant.

Various types of valving devices for use with centrifuges are well known in the art, as exemplified by Dibble Patent 921,371, granted May 11, 1909. Such valving devices function to relieve a centrifuge rotor section of an accumulation of sediment or sludge, but the known constructions have been complex in structure and often unreliable in operation. Most often conventional centrifuge apparatus requires a complete shut down for an adequate removal of sludge or solid matter, and where valving devices are used, complex mechanical linkages associated with the valves have required considerable adjustment and maintenance.

The present invention provides for an improved discharge valve means for removing sludge from a centrifuge, and the discharge valve means is simple and rugged in construction and very reliable in operation over a range of centrifuge rotation speeds. Further, the operation of the valve means of this invention is automatic when a predetermined amount of sludge has accumulated in the centrifuge rotor, and no timing devices or costly linkages are required to effect the automatic operation of the discharge valve means.

The discharge valve means of this invention includes a lever operated valve element which is biased toward a closed position by centrifugal action on a counterweight when the centrifuge is operating. The valve element and the counterweight are carried on opposite ends of the lever so that centrifugal force on the lever acts directly through the lever to maintain the valve element in a normally closed position. The discharge valve means includes an inlet tube which receives sludge or sediment from the operating centrifuge, and as the sludge accumulates in the valve tube, centrifugal action causes an increase in force against the valve element in a direction which opposes the closing force from the counterweight. At a predetermined level of sludge accumulation, the centrifugal forces on the counterweight become overbalanced by the force on the valve element, and the valve is biased to an open position. Because of continued centrifugal forces acting on the sludge accumulation, the sludge is expelled through the open valve, and when the sludge accumulation has been reduced sufficiently, the valve is again closed by the action of the counterweight overcoming the lesser centrifugal force on the remaining sludge.

An important feature of the present invention resides in the relationship of the counterweight to the accumulating sludge. Both the counterweight and the sludge are affected by the same centrifugal action of the centrifuge and the force of the centrifuge and the forces of the centrifuge are transmitted to both in direct equal proportion. Thus, of the rotating speed of the centrifuge is increased or decreased, the force acting on the counterweight will change in proportion to the change in force on the accumulated sludge in the valve inlet tube. In this manner, the discharge valve means of this invention acts automatically and reliably for all centrifuging operations and speeds.

The discharge valve means of this invention has the further advantage of being easily adapted to and installed on many types of centrifuge constructions, and the valve means is economically manufactured with no costly linkage elements.

Other features and advantages of the centrifuge valve of this invention will become apparent in the more detailed discussion which follows, and in that discussion reference will be made to the accompanying drawings, in which:

FIGURE 1 is a cross-sectional elevational view of a centrifuge rotor incorporating the discharge valve means of this invention;

FIGURE 2 is a cross-sectional view of the valve means and associated structure taken on line **2—2** of FIGURE 1; and

FIGURE 3 is an end view of the valve as seen from line 3—3 of FIGURE 2.

Referring to FIGURE 1, a centrifuge construction is illustrated with a sludge discharge valve of this invention shown in a preferred mounted position relative to the centrifuge. The centrifuge device may be of any well known construction having a rotatable centrifuge rotor or bowl **10** for separating solid compounds from liquids which are contained within the centrifuge while it is rotated. The centrifuge rotor **10** is shown as being mounted on a vertical axis of rotation, and an electrical motor means **12** is connected to a drive shaft **14** for rotating the centrifuge bowl **10**. The drive shaft **14** is mounted in bearings **16** and rigidly connected to an upper portion of the centrifuge rotor so that rotational forces applied to the drive shaft by the motor will be transferred to the centrifuge rotor **10**. Alternatively, the centrifuge rotor and driving means can be mounted on a non-vertical axis, and such a centrifuge construction is disclosed in Weiland Patent 2,788,937, granted Apr. 16, 1957.

The illustrated centrifuge device is of a type which is suspended into a liquid **18** which is to be centrifuged. The liquid **18** is contained within a non-rotating housing **20**, and suitable means (not shown for clarity) are provided for admitting liquid into the housing and maintaining a requisite level of such liquid for entry into the centrifuge bowl. When the centrifuge is rotated, liquid **18** is received into an annular inlet opening **22** which is directed downwardly into the liquid bath **18**. The inlet opening branches outwardly along a tapered inner wall **24** at the bottom of the centrifuge so that incoming liquid is drawn into the inlet **22** and thrown outwardly toward the maximum diameter portion of the centrifuge rotor while it is rotating. The flow of liquid through the centrifuge bowl is illustrated by the arrows of FIGURE 1, and it can be seen that after centrifuging, the liquid passes through a conventional straining drum **26** having a nest of frustoconical discs or rings **28** which are spaced from each other and concentric with the rotational axis of the centrifuge bowl. The centrifuged liquid which has had solid particles contained therein removed by the centrifuging action then passes into an inner chamber **30** which is contained within the confines of the straining drum **26**. The centrifuged liquid is received into a branched end **32** of an outlet pipe **34** for delivery to a suitable receiving means. Thus, it can be seen that the centrifuging action provided by the above described device is substantially

conventional to prior systems, and a means is provided for feeding liquid into the centrifuge for a separation of solid particles therefrom, and a means is further provided for removing the centrifuged liquid from the operating centrifuge.

During the centrifuging operation, solid particles are accumulated within the maximum diameter portion of the centrifuge rotor, as indicated at **36** in FIGURE 1. The accumulation of such particles forms a sludge deposit which must be periodically removed from the centrifuge and this normally requires a shut down of the centrifuging operation to effect a cleaning of the centrifuge rotor.

The present invention provides for a discharge valve means which can be easily mounted through a wall of the centrifuge rotor or bowl for automatically discharging accumulations of sludge and other deposits from within the rotor when such deposits periodically build up to a predetermined amount. The sludge discharge valve means **38** is preferably mounted through a wall of the centrifuge rotor **10** at a point of maximum diameter of the centrifuge bowl. However, in alternative centrifuge bowl constructions, the sludge discharge valve **38** can be mounted through any wall portion of the centrifuge which receives an accumulation of sludge or solid matter.

The sludge discharge valve means includes a valve opening through the wall of the centrifuge rotor, and this opening may be in the form of a bore which is made through the wall and directed outwardly from the interior of the centrifuge bowl. In the preferred form of the invention, the opening is provided by a tubular element **40** placed within a bore which has been formed through the centrifuge bowl **10**. The tubular element **40** can be eliminated if an appropriate diameter bore is formed through the centrifuge bowl wall, but it is preferred to use a tubular element for extending an outlet end **42** of the opening beyond the outer surface of the centrifuge rotor. By extending the outlet of the discharge valve beyond the outer surface of the centrifuge rotor, a lever can be pivotally mounted for rocking movements relative to a valve element, and the valve element can be actuated by the lever to open and close the discharge opening. The outlet end **42** of the tubular element **40** is normally closed by a valve element **44** which is retained in a closed position by centrifugal force acting on a counterweight. The counterweight is carried by a lever which moves the valve element to a normally closed position when the centrifuge rotor is operating. When sufficient sludge accumulates at **36** within the centrifuge bowl, centrifugal forces acting on the sludge will ultimately overcome the closing effect of the counterweight, and sludge will be discharged past the valve element through the outlet end of tubular element **40**.

The particular construction of the actuating means associated with the discharge valve of this invention can be seen by a reference to FIGURES 2 and 3. The valve element **44** is illustrated in the form of a ball valve, however any other valving element may be used which provides for a closure of the outlet end **42** of the tubular element **40**. The valve element **44** is normally held tightly against the outlet end of the tubular element **40** by one end **46** of a lever **48**. A recess **50** is formed within one face of the lever for supporting the valve element **42**, and a back wall **52** of the recess presses against the valve element **44** to provide for a tight closure of the tubular discharge element **40** by the valve element. The lever **48** is fulcrumed at its midpoint at **54**, and this fulcrum may be in the form of a pin which mounts the lever **48** on a projecting rod **56** for limited pivotal movement about the end of the rod. The rod **56** is provided with a bore through its projecting end for receiving the mounting pin at **54**, and the lever **48** is thereby retained near the end of the rod for limited pivotal movement. The rod **56** is mounted through a wall portion of the rotor **10** to provide a rigid fulcrum point for the lever **48**. An opposite end **58** of the lever is formed of a sufficient mass of material to provide a counterweight to that end of the lever. Alternatively, weights can be added or affixed to the opposite end of the lever **48** but it has been found that the entire lever means may be fabricated from a metal or other suitable material which provides a sufficient counterweight effect when formed in the construction shown in FIGURE 2. It will be appreciated that there is a greater weight on the end **58** of the lever than on the end **46** since the recess **50** removes a quantity of material and weight from the end **46** of the lever.

When the sludge discharge valve is in its operative position, the tubular discharge element **40**, and the projecting rod member **56** are mounted in a common plane which is at right angles to the rotational axis of the centrifuge rotor **10**. When the centrifuge rotor is rotated, forces are directed outwardly in that plane, and the centrifugal action causes the counterweight end **58** of the lever **48** to move outwardly with a greater amount of force than the lighter-weight end **46**. As a result, the ball valve **44** is pressed snugly against the outlet end **42** of the tubular element **40** while the centrifuge is operating. This closed position of the valve element **44** is maintained by the action of the centrifuge until sufficient force is added to the lighter end **46** of the lever to overbalance the existing force on the counterweight end **58** of the lever. This condition arises when sufficient quantities of solid material or sludge have entered the outlet tube **40** and have been forced against the valve element **44**. Since the centrifugal force of the operating centrifuge acts upon the sludge which is accumulating within the tubular element **40**, a point is reached where sufficient force is applied against the valve element **44** to force the valve open for a discharge of sludge material. The discharge action occurs periodically because as soon as a quantity of sludge has been discharged, conditions are again created for greater forces to be applied to the counterweight **58** than to the valve element **44** and the valve is closed.

The pivotal mounting of the lever **48** on the projecting rod **56** is also illustrated in FIGURE 3, and it is preferred that the projecting end of the rod **56** be carried within a recess **60** formed in the central portion of the lever **48**. This construction provides for a limited rocking movement of the lever **48** about the end of the projecting rod **56**, and this prevents a substantial movement of the end **46** of the lever away from the outlet **42**. Too much of a movement of the lever end **46** would allow the ball valve **44** to drop from its position within the recess **50**, and the preferred construction described above provides for a retaining of the valve within its recess without a requirement for a spring device or other retaining means.

Because the sludge discharge valve of this invention is operated entirely by centrifugal forces acting on opposite ends of a lever and on an accumulation of sludge which is in contact with one end of the lever, there is provided an automatic proportioning of the opening and closing of the valve element to whatever speeds of rotation are being applied to the centrifuge rotor. As the speed of rotation is changed, the centrifugal forces are likewise changed and have a direct effect upon both ends of the lever **48** which actuates the valve element **42** of the sludge discharge valve. Thus, the sludge discharge valve of this invention is useful for all centrifugal speeds and forces, without an adjustment of complex linkages or elements such as are normally associated with similar devices.

Having described the invention, it can be seen that there is provided a simple, rugged construction which is entirely reliable in its function of periodically and automatically discharging sludge from a rotating centrifuge. The automatic operation of the sludge discharge valve permits a continuous operation of the centrifuge without lost time for shut down and cleaning. Additionally, the device of this invention is easily adapted to existing structures with little modifictaion and with little cost. Although the device has been described with reference to a preferred embodiment, variations will become apparent to those

skilled in the art, and such variations are intended to be included within the scope of this invention.

I claim:

1. In a centrifuge having a rotor means for centrifuging and sparating solid matter form a liquid medium, and having a discharge valve means in said rotor for releasing accumulations of solid matter from said rotor, the improvement in said discharge valve comprising:

a valve opening through a wall of said rotor for passage of solid matter therethrough when said valve is open,

a lever means for carrying a valve element for opening and closing said opening, said valve element comprising a ball valve means loosely carried in a recess formed in a first end of said lever means and in alignment with said valve opening for opening and closing the same, whereby said loosely carried ball valve means can adjust its position over said valve opening for tightly closing the opening,

a counterweight carried at a second end of said lever means, and said lever means having a fulcrum intermediate said first and second ends, and

means for receiving an accumulation of sludge within said rotor and for directing the outward force of the accumulated sludge against the valve member during rotation of the rotor, whereby centrifugal forces of said rotor will bias said counterweight in a direction which maintains said valve element in a normally closed position until accumulated solid matter within said rotor forces said valve open against the biasing effect of said counterweight.

2. The improvement of claim 1 wherein said rotor includes a tube means communicating between said valve element and the interior of said rotor, said tube means providing an extension outwardly from the outer wall of said rotor, whereby said lever can be mounted for swinging movement about its fulcrum away from the outer wall of the rotor.

3. The improvement of claim 1 wherein said valve element and said counterweight are mounted in a common rotataional plane of said centrifuge rotor.

4. The improvement of claim 1 wherein said valve opening is positioned at a maximum internal diameter of said centrifuge.

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