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VALVE DEVICE IN CENTRIFUGAL SEPARATORS FOR SEPARATING SLUDGE FROM LIQUIDS

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Fig. 1

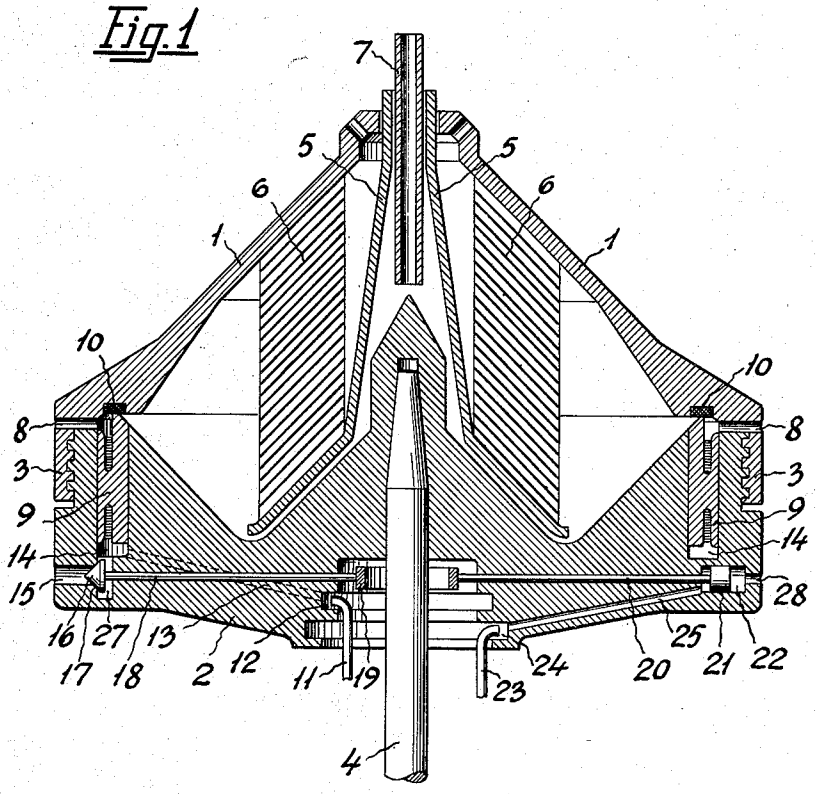
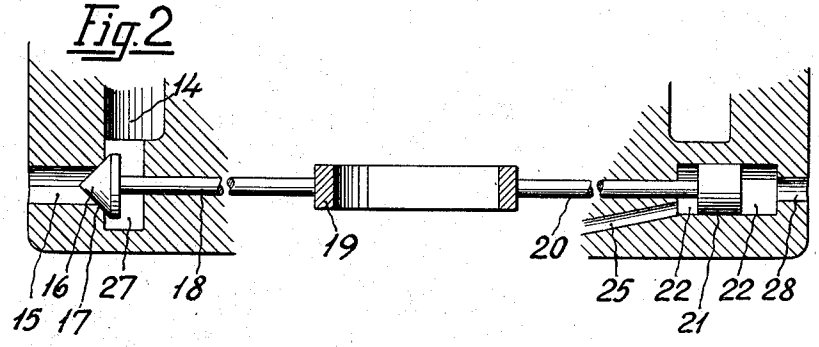


Fig. 2



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VALVE DEVICE IN CENTRIFUGAL SEPARATORS FOR SEPARATING SLUDGE FROM LIQUIDS

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2 Claims. (Cl. 233—20)

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The present invention relates to an improvement in and relating to sludge separators, more particularly to an improved valve device in a centrifugal separator for separating sludge from liquids, the term sludge being considered as designating not only impurities in liquids but any material including a large proportion of solids of higher specific gravity than the liquids in which they are suspended.

The separators in question may for instance be of the type in which the separator bowl is divided into relatively displaceable parts which at periodic intervals during the operation of the separator may be displaced to open discharge slits or discharge apertures through which the sludge deposited within the separator bowl may be discharged. Such a centrifugal separator is e. g. described in the specification to U. S. Patent No. 2,091,329 and includes an annular piston arranged for reciprocal displacement within the separator bowl, which piston is moved to sealing contact with an annular gasket for closing the discharge apertures by means of an operating liquid that is introduced under influence of centrifugal force into a groove below said piston, whereas the piston is displaced in the opposite direction for opening the circumferential discharge apertures by means of the hydrostatic pressure of the fluid within the separator bowl when the said operating liquid is discharged from beneath the piston through outlets controlled by piston valves that are operated intermittently by means of a maneuvering liquid introduced into the separator.

When separating certain kinds of sludge in centrifugal separators of the said type it has been found to be of great importance for attaining a satisfactory operation of the separator that the sludge discharge apertures are quickly opened to their full extent and kept fully open a sufficiently long time to allow tough sludge, or sludge that adheres to the wall of the separator bowl, to slide out of the bowl with as little resistance as possible. The piston valve described in the specification to U. S. Patent No. 2,091,329 does not operate sufficiently rapid under such conditions. This will especially be the case when applied in large separators, in which the displacement of the annular piston requires the rapid discharge of a relatively large quantity of operating liquid from beneath the piston in order to open the sludge discharge apertures.

For the quick discharge of a large quantity of operating liquid a maneuvering valve must have a relatively large sectional area of flow.

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The valve member will thus be relatively large and have considerable weight, and consequently will be actuated by a correspondingly large centrifugal force which, during the opening of the valve, has to be counteracted by a considerable hydrostatic pressure in a maneuvering liquid that is introduced into a compartment in the separator bowl outside the valve member, and which likewise shall counteract the pressure of the liquid on the valve member. To provide a sufficiently great pressure upon the valve member by means of the maneuvering liquid which has less mass than the mass of the valve member, this valve member must have a large diameter in relation to its length, or the compartment encompassing the operating liquid must be placed at a considerable greater distance from the rotation axis of the separator bowl than the distance from this rotation axis to the center of gravity of the valve member. However, as the available space within separator bowls is strictly limited, this arrangement of suitable valves provides considerable difficulties. The tight fitting of the valve member, and its friction upon displacement, are likewise important points to be considered when desiring to obtain a rapidly operating valve member.

The object of the invention is therefore to remedy such deficiencies in valves of hitherto known construction, and to provide a valve that possesses a great sectional area of flow, operates easily, and may be operated by means of a relatively small quantity of operating liquid. This is essentially obtained by constructing the valve in such a manner, that its valve member, or its valve cone, is so connected to means counterbalancing it to such an extent that, during the rotation of the separator bowl, it may only be actuated by a small surplus of force for closing when not subjected to actuation by a maneuvering liquid influenced by the centrifgal force.

The said means for counterbalancing the valve member or valve cone may according to the invention comprise a counterweight that is connected to the valve member, or valve cone, and displaceably disposed within a compartment formed in the side of the separator bowl opposite, but not necessarily diametrically opposite, to that in which the valve member or valve cone is disposed. Furthermore the said compartment may according to the invention be connected to supply and discharge passages in such a manner that the operating liquid influenced by the centrifugal force may be supplied to the said compartment to displace the counterweight together

with the valve member, or valve cone, attached thereto for opening the valve, and thereupon automatically discharge the operating liquid from the separator bowl.

According to the invention it is likewise possible to connect the compartment beneath the annular piston to the compartment disposed on the inner side of the valve member, or valve cone, so that the liquid also actuates the valve member, or valve cone, for closing the valve discharge opening.

Furthermore, the connection between the valve member, or valve cone, and the counterweight may be so formed that it extends around or outside the shaft of the machine.

In such a balanced valve member, or valve cone, only a small quantity of maneuvering liquid is required for maneuvering even large valves with considerable sectional area of flow. In this manner a rapidly operating valve is provided.

Further features and advantages of the invention will be apparent from the following detailed description in connection with the attached drawing, in which

Fig. 1 is a central axial sectional view of a separator bowl provided with a valve according to the invention, and

Fig. 2 is a detail view of the valve on a somewhat larger scale showing the counterweight and connections, the surrounding parts being shown in section.

Referring to the drawing, the separator bowl is divided into two coaxial parts, viz. an upper part 1 and a lower part 2, which parts in known manner are interconnected by means of a threaded ring 3, or by means of bolts. The separator bowl is mounted on a shaft 4 that may be rotated at a high speed by means of transmission members not included in the drawing. The bowl is provided with a central tube 5 that carries a suitable disc insert 6 and encompasses a feed tube 7 for feeding the material to be treated to the separator bowl. This bowl has a single or several discharge openings 8 through which sludge may be discharged from the bowl. Normally these discharge openings 8, during the operation of the machine, are closed by means of an annular piston 9—which also may form the entire internal part of the bowl—disposed for reciprocal movement within a groove or annular chamber 14 in the lower part 2 of the separator bowl. This piston is held to sealing contact with a gasket 10 in the upper part 1 of the separator bowl, by means of liquid influenced by centrifugal force, which liquid is conveyed by centrifugal force to said groove 14 beneath the piston 9 through a stationary tube 11 communicating with an annular groove 12 and a passage 13 in the lower bowl part 2. When the liquid is ejected from the groove 14 through a discharge opening 15 and a valve associated therewith, the hydrostatic pressure within the separator chamber will force the piston 9 downwards to open the discharge opening or openings 8 to allow discharge of sludge from the bowl.

The valve for the discharge opening 15 in the construction illustrated is formed as a cone valve provided with a valve cone 16 which in its closed position abuts a valve seat 17 surrounding the opening 15. By means of a connecting rod 18, a ring 19 encompassing the spindle 4, and another connecting rod 20, the valve cone 16 is attached to a counterweight 21 arranged for reciprocal movement within a chamber 22 formed in the opposite side of the separator body, the counterweight being in the form of a sliding piston actuated in one direction by means of a maneuvering liquid influenced by centrifugal force. This maneuvering liquid is conveyed by centrifugal force to the inner part of the chamber 22 at the innermost end of the counterweight 21 through a stationary tube 23, an annular groove 24 formed in the separator bowl, and a passage 25. The weight of the counterweight 21 and its connection rod 20 is such, that the centrifugal force resulting from the rotation of the separator bowl and acting on these parts is equal to the centrifugal force acting on the cone valve 16 and its connecting rod 18, and hence these parts on opposite side of the shaft 4 are balanced in such a manner that only a slight surplus of force actuates the valve to close the discharge opening 15, when not subjected to counteracting influence by liquid under action of centrifugal force.

The lower end of the groove 14 communicates in such a manner with a compartment 27 behind the cone valve 16 that the operating liquid also actuates this valve to close the discharge opening 15. In this manner a powerful closing actuation of the cone valve is attained even though the valve is balanced by the counterweight 21.

The balancing of the cone valve is determined by the weight of the counterweight 21 in relation to the weight of the cone valve 16, and to the distance of the counterweight from the rotation axis of the bowl; but in any case, the cross sectional area of the counterweight and its distance from the rotation axis should be such that the sum of the centrifugal force upon the counterweight, and the pressure of the operating liquid influenced by the centrifugal force thereon, is greater than the sum of the centrifugal force on the cone valve 16 and the pressure of the closing liquid thereon. When a proper counterbalancing of the cone valve 16 is provided, no greater quantity of operating liquid is required for operating a large valve than that required for operating a small valve. Furthermore, this construction provides a tight and easy movable valve, because the counterweight need not fit tightly in the chamber 22. The leakage between the counterweight and the chamber wall is utilized, during the actuation by the centrifugal force, to discharge the maneuvering liquid from the compartment 22 at the inner end of the counterweight to the outer end of the compartment from which latter the liquid is ejected through the discharge opening 28.

When the maneuvering liquid admitted through the parts 23, 24 and 25 is shut off and the operating liquid is again admitted through parts 11, 12 and 13, the cone valve 16 will be moved to close the discharge opening 15 by the centrifugal force, and the piston 9 will be moved upwardly to close the sludge discharge opening or openings 8.

A single or several valves as described may be employed in the same separator.

The invention is not limited to the manner of construction of the bowl or the valve device as described and illustrated in the drawing, and it is obvious that various modifications are possible without departing from the scope of the invention as defined in the following claims.

I claim:

1. In a centrifugal separator, the combination of a centrifugal bowl mounted for rotation about a vertical axis to effect continuous discharge of a liquid effluent and provided with peripheral sludge discharge openings for concentrated suspended solid material within the bowl, a piston for controlling the sludge discharge through said

openings and mounted for axial reciprocation within the bowl, said piston being actuated to intermittent displacement by means of an actuating liquid influenced by centrifugal force and conducted to a space below said piston, the body of said bowl having a compartment communicating with said space below said piston and provided with a discharge for the actuating liquid, a valve member to close and open said discharge and mounted in said compartment on one side of the vertical axis of the bowl, a counterweight slidable within a space in the bowl body opposite to the discharge for the actuating liquid and a rod-connection between the counterweight and the valve member, hydrostatic means for creating a pressure to displace the counterweight and move the valve member to its open position to permit the discharge of the actuating liquid and the simultaneous movement of the piston to its open sludge-discharging position, and means for releasing the hydrostatic pressure on the counterweight.

2. In a centrifugal separator, the combination of a centrifugal bowl mounted for rotation about a vertical axis to effect continuous discharge of a liquid effluent and provided with peripheral sludge discharge openings for concentrated suspended solid material within the bowl, a piston for controlling the sludge discharge through said openings and mounted for axial reciprocation within the bowl, said piston being actuated to intermittent displacement by means of an actuating liquid influenced by centrifugal force and conducted to a space below said piston, the body of said bowl having a compartment communicating with said space below said piston and provided with a discharge for the actuating liquid, a valve member to close and open said discharge and mounted in said compartment on one side of the vertical axis of the bowl, a counterweight slidable in a space in the bowl body diametrically opposite the discharge for the operating liquid, a ring surrounding the spindle on which the separator bowl rotates, a rod connecting the ring to the counterweight, another rod connecting the ring to the valve member, and hydrostatic means for actuating the valve, displacing the counterweight and simultaneously allowing movement of the piston to its open sludge discharge position.

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