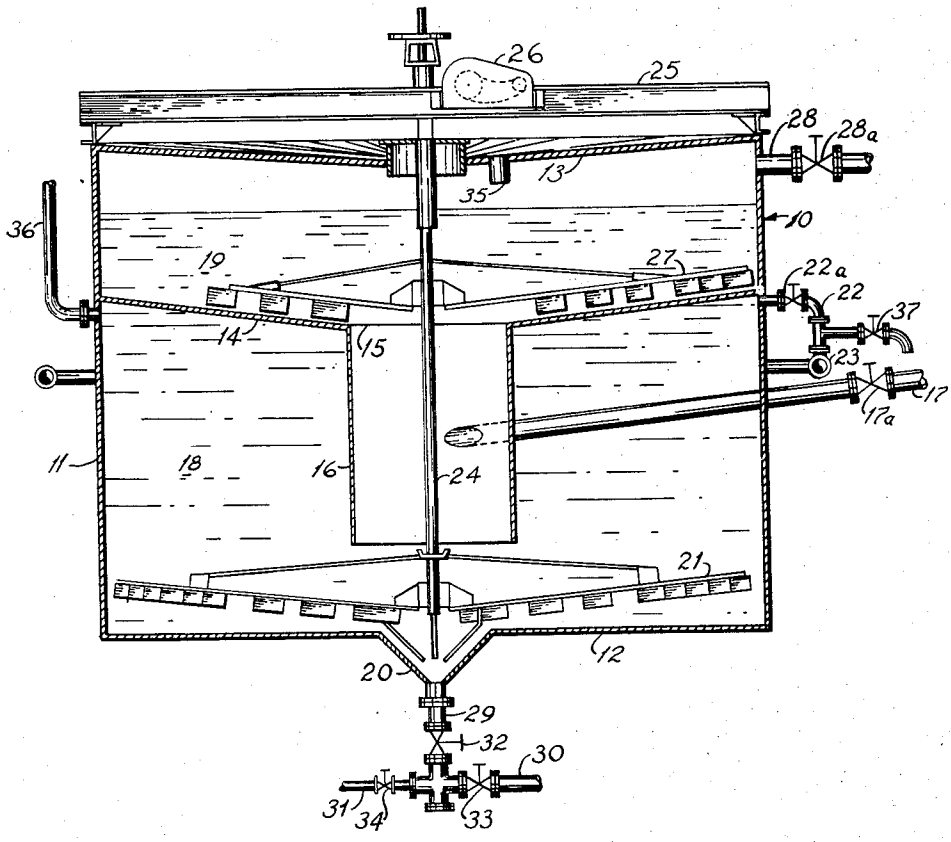
Sept. 16, 1958 C. H. KNIGHT ET AL 2,852,138

METHOD OF AND APPARATUS FOR CLARIFYING LIQUIDS

Filed Sept. 4, 1956



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United States Patent Office 2,852,138
Patented Sept. 16, 1958

2,852,138

METHOD OF AND APPARATUS FOR CLARIFYING LIQUIDS

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Application September 4, 1956, Serial No. 607,789

3 Claims. (Cl. 210—83)

This invention relates to clarification, settling and like tanks.

In many industrial processes involving the use of clarification and settling tanks the need arises for keeping the tank adequately supplied regardless of fluctuations in the supply of the mother liquor thereto. The usual expedient adopted to even out the feed rate is to provide storage or surge tanks by means of which a reserve supply is built up, but such storage or surge tanks introduce certain difficulties, for example, the need arises for maintaining the feed and, because the tanks are quite large and often located at different levels, problems of floor space and plant layout develop. Typically, in one field in which the present invention is especially useful, namely in the recausticizing of kraft green liquor such as is used in sulphate pulp processes in the pulp and paper industry, it has been general practice to provide a green liquor surge or storage tank in the flow line between the smelt dissolvers and the green liquor clarifier.

It is an object of the present invention to provide a structure in which clarification or settling equipment and facility for storage and/or for accommodating surges in supply or demand are embodied in a single unit.

It is, incidentally, a feature of the invention that not only is the normally expected simplification of plant layout and saving of floor space achieved, but also that improved operation can result as will later be understood from the ensuing description.

It is, moreover, an advantage of the present invention that the objects of the invention can be achieved by comparatively simple modification of existing equipment.

In order that it may be clearly understood and more readily carried into effect, the invention will now be described, by way of example, with reference to the accompanying drawing which is a sectional elevation taken through a clarifier according to the present invention.

In the drawing the reference numeral **10** indicates a tank structure having a peripheral wall **11**, a bottom closure **12** and a dished top cover **13**. At a point intermediate the top and bottom of the tank there is provided a tray **14** of dished form disposed generally horizontally and having a central opening **15** leading downwardly into a feedwell **16**. Mother liquor to be treated is fed into the feedwell **16**, preferably tangentially, through the feed supply conduit **17** and flows downwardly into the lower compartment **18** until that lower compartment is full, whereafter the liquor flows upwardly from the feedwell **16** into the upper storage or surge compartment **19**. Solids settling out from the liquor in the lower compartment, which can be regarded as the clarifying compartment, collect on the bottom **12** and are raked inwardly toward a central discharge cone **20** by the rotating rake structure **21**. Clarified liquor flows out of the main thickening or settling compartment through outlets provided at angularly spaced points immediately subjacent the underside of the tray **14** through suitable connection conduits **22** (only one of which is seen in the drawing)

connected with a common manifold **23** from which the clarifier liquor is discharged for subsequent use or treatment.

The raking mechanism **21** is carried by a shaft **24** supported by a suitable bearing structure conveniently mounted on the usual diametrically extending bridge structure **25** which also conveniently mounts a prime mover **26** or equivalent drive gear for rotating the shaft and thereby the rake mechanism **21**.

Raking mechanism **27** is preferably also provided in the storage or surge compartment **19** for raking toward the opening **15** and feedwell **16** solids settled out from the liquor in the storage or surge compartment **19**, such rake mechanism conveniently being carried for rotation by the shaft **24**. The liquid level in the storage or surge compartment **19** can be prevented from exceeding a predetermined level by overflow through the overflow drain conduit **28** which may feed back to the source of mother liquor supply.

A sludge discharge conduit **29** leads out from the cone **20** and branches out into the conduits **30** and **31**. The conduit **30** serves for conducting the sludge away for disposal when the valves **32** and **33** are open, whereas, when the valve **33** is closed and the valves **32** and **34** are open, wash liquid can be introduced through the conduit **31** for cleaning purposes.

Throughput of liquor and therefore residence time in the clarifying compartment **18** is normally controlled by suitable valve means. Thus, the feed rate through the conduit **17** can be controlled by the valve **17***a*, and similar control valves such as **22***a* can be operated for regulating the clarified liquor discharge to the discharge manifold **23**. A discharge control valve **28***a* can also be provided in association with the upper compartment overflow **28**, and in all cases the control means can be actuated manually or provision may be made for automatic control.

A cover drain **35** is preferably provided through which any moisture or overflow collected in the dished cover plate **13** can flow into the upper compartment **19**. The cover drain **35** is particularly useful if the overflow **28** is provided with a valve which can be closed, for, in that event the cover drain **35** can serve to vent the upper compartment **19** and by overflow can serve to indicate when the upper compartment **19** is full. In that respect, it may be a desirable manner of operation deliberately to close the overflow outlet valve **28***a* in order to ensure that the upper storage or surge compartment is full in anticipation of a subsequent interruption of mother liquor supply.

If initial filling with mother liquor is effected with the lower compartment discharge valves **22***a* closed, air will be entrapped beneath the underside of the tray **14**. If that happens, the effect would be that on opening the valves **22** for starting operation, there would be a rush of liquor upwardly in the unit to replace the air being released through the discharge line, with the result that agitation could occur and the unit would not function properly as a clarifier. It is therefore desirable to provide means for venting the top of the lower compartment **18** to atmosphere, for example, through the vent pipe **36**. Though only one such pipe is shown in the drawing it will in practice be preferred to have three such vent pipes spaced 120° apart.

It is also desirable that a sample valve should be provided on the lower compartment discharge or through the tank wall just below the tray **14**, so that samples can be drawn off to determine the clarity of the liquor being discharged. Such a sample valve is indicated by way of example at **37**. If desired sample valves can be provided at several elevations on the unit.

In normal clarifying operation the supply of mother

liquor through the conduit **17** proceeds until the bottom compartment is full and the top compartment is approximately half full. If, owing to some oversight in operation, the level in the upper compartment should rise, due to the hydraulic influence of increased feed, to the extent of filling the upper compartment, the excess would merely discharge by overflow through the overflow discharge conduit **28**. When filling has been completed the discharge of clarified overflow from the clarifying compartment **18** is adjusted in relation to the normal feed rate of mother liquor entering through the conduit **17** so that a predetermined level will be maintained in the surge or storage upper compartment **19**. If the rate of feed of mother liquor through the conduit **17** increases for any reason the overflow discharge conduit **28** accommodates any necessary overflow, the overflow generally being cycled back to the supply source. On the other hand, if the mother liquor feed rate is interrupted the supply to the clarifier compartment **18** is maintained through gravity flow through the feedwell **16**.

It is a noteworthy feature of the structure according to the present invention that not only are storage and surge accommodation facilities combined with a clarifier in a single structure, but, in addition, an operational improvement results. Thus, the preliminary settling of solids which inevitably occurs in the surge or storage upper compartment **19** results in considerable clarification of the liquor therein and the there settled solids or pulp raked into the feedwell **16** pass in isolation through the upper increasingly clarified layers in the clarifying compartment **18** where they merge with the settled solids at the bottom of the lower compartment with minimum contamination of the clarified liquor in the lower compartment. In that respect, it will be noted that the feedwell **16** is of sufficient depth to reach down to the lower part of the lower compartment **18**. The effect is cumulative because the settled solids descending from the upper compartment, by contact with downwardly settling solids which have already reached the lower part of the clarifying compartment, tend to amalgamate, as a result of which the overall settling tendency is increased. Likewise, the liquor which feeds into the clarifying lower compartment from the upper compartment being already partially clarified results in an improved overall clarification.

Another significant factor is that an existing installation can be adapted to the teachings of the present invention with a minimum of structural modification by the simple expedient of installing the tray and feedwell structure **14** and **16** with the feed conduit leading into the feedwell, and if necessary or desirable, extending the tank walls upwardly. The upper raking structure **27** can be carried by the same driven shaft **24** which carries the lower rake mechanism **21** which is anyway customarily present.

Although the embodiment of the invention described is especially applicable to the clarification of green liquor in the pulp and paper industry, the scope of the invention is limited neither to that embodiment nor that environment. The invention is, indeed applicable in any circumstances in which it may be desirable to provide for continuity of supply despite fluctuations in availability at the source. As an indication of a somewhat different environment one can envisage utility of the invention in other processes such, for example, as in its application flotation systems where it is likewise desirable to have facility for storage or to accommodate surges.

We claim:

1. A clarifier comprising a tank having a bottom and a confining marginal wall upstanding therefrom, an annular tray extending inwardly from the marginal wall at a height intermediate the top and bottom thereof to define below said tray a clarification compartment in communication through a substantially central opening defined by said tray with a superjacent tray compartment, sediment raking means at the bottom of said clarification compartment operable to rake materials settled therein toward a substantially central sediment discharge outlet, clarified liquor overflow discharge means leading out from the clarification compartment subjacent the periphery of said annular tray, a feedwall leading from the central opening defined by said annular tray into the lower part of the clarification compartment, feed conduit means extending through the marginal wall of the tank and said clarification compartment for discharging mother liquor to be clarified directly into said feedwell and therefrom downwardly until the clarification compartment is full and thereafter upwardly into the subjacent tray compartment, overflow discharge means leading out from said tray compartment at a predetermined elevation above said tray and thereby normally operable to determine a maximum liquid level in said tray compartment, and valve means associated with said clarified liquor overflow means enabling control of the clarified liquor discharge rate independently of the rate of feed supplied through said feed conduit.

2. Apparatus according to claim 1, having the raking mechanism in the clarification compartment carried by a rotatably driven shaft extending through said tray compartment, said feedwell and into the lower part of said clarification compartment, and further including raking mechanism in said tray compartment also drivingly carried by said rotatably driven shaft.

3. The improved method of operating a clarifier in which solids are separated from liquids by sedimentation and clarified liquid is discharged from an upper portion of said clarifier; said improved method comprising the steps of substantially fixing the rate of clarified liquid discharge in proportion to a pre-selected rate of clarifier feed; and maintaining said fixed clarified liquor discharge rate to be substantially constant during periods of feed rates varying from said preselected rate by compensating for increased feed rates by forcing excess feed upwardly under the hydraulic influence of such increased feed into a functionally remote superjacent storage zone maintained in hydraulic communication with said clarifier, and automatically compensating for deficiencies in feed resulting from decreased feed rates by gravity flowing material downwardly from said storage zone into said clarifier at a rate proportioned to the decrease in feed rate.

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