Feb. 24, 1970 T. M. JABLON 3,497,184

AGITATING APPARATUS FOR FLOCCULATING TREATMENT OF SUSPENSIONS

Filed Aug. 14, 1968 2 Sheets-Sheet 1

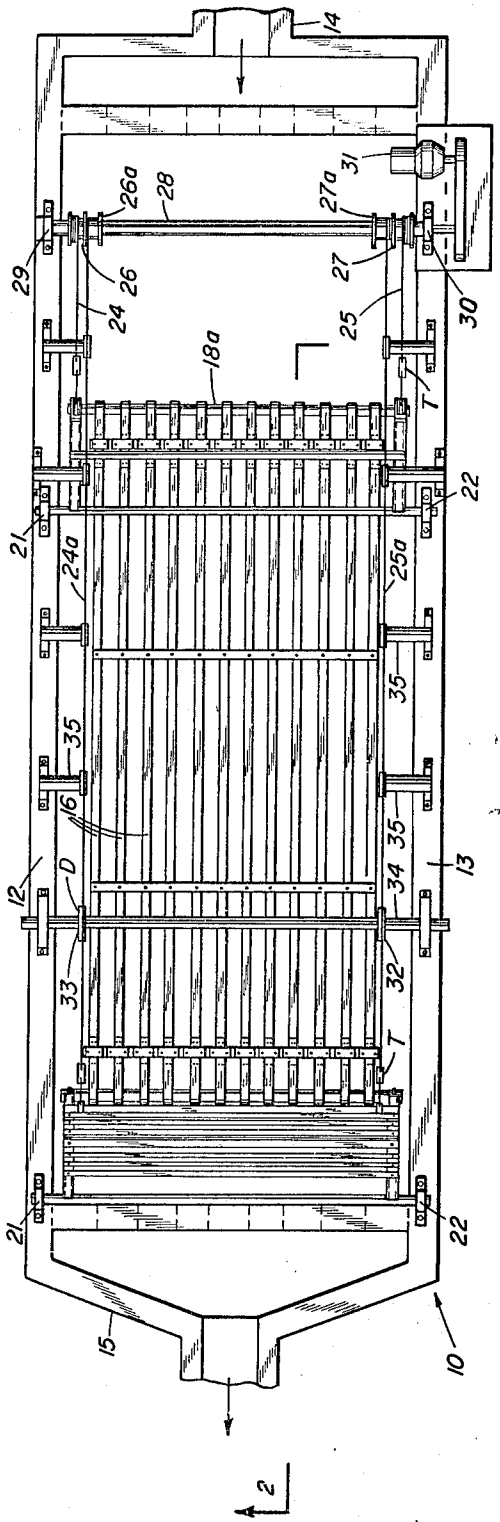

FIG. 1

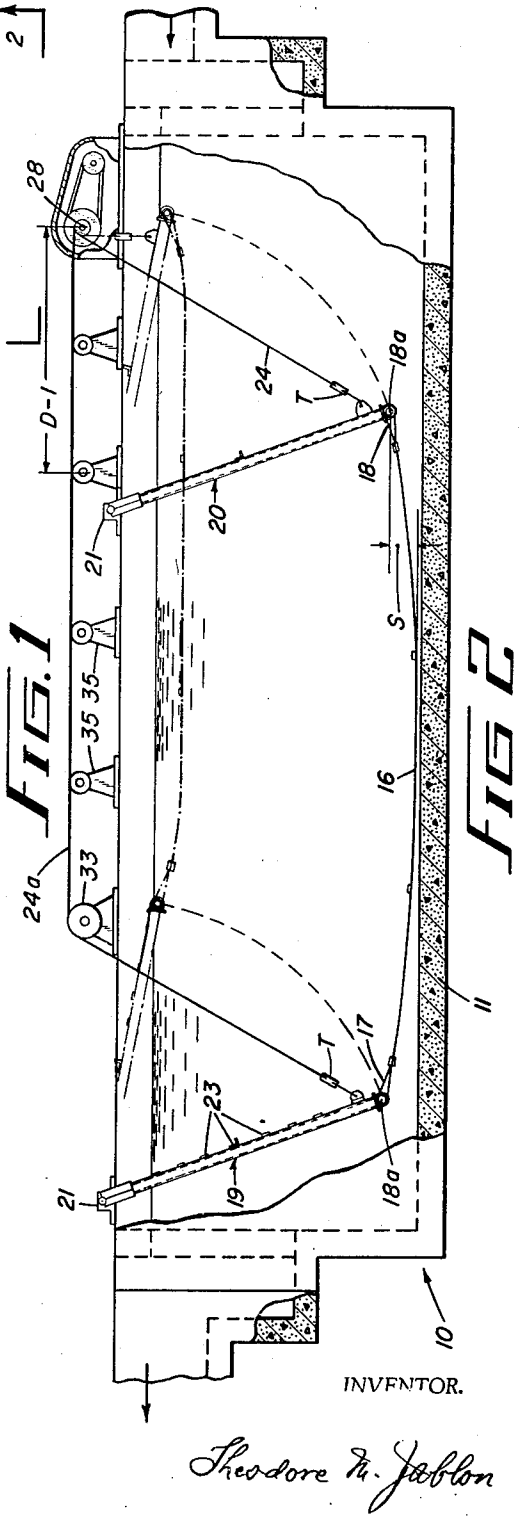

FIG 2

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AGITATING APPARATUS FOR FLOCCULATING TREATMENT OF SUSPENSIONS

Filed Aug. 14, 1968 2 Sheets-Sheet 2

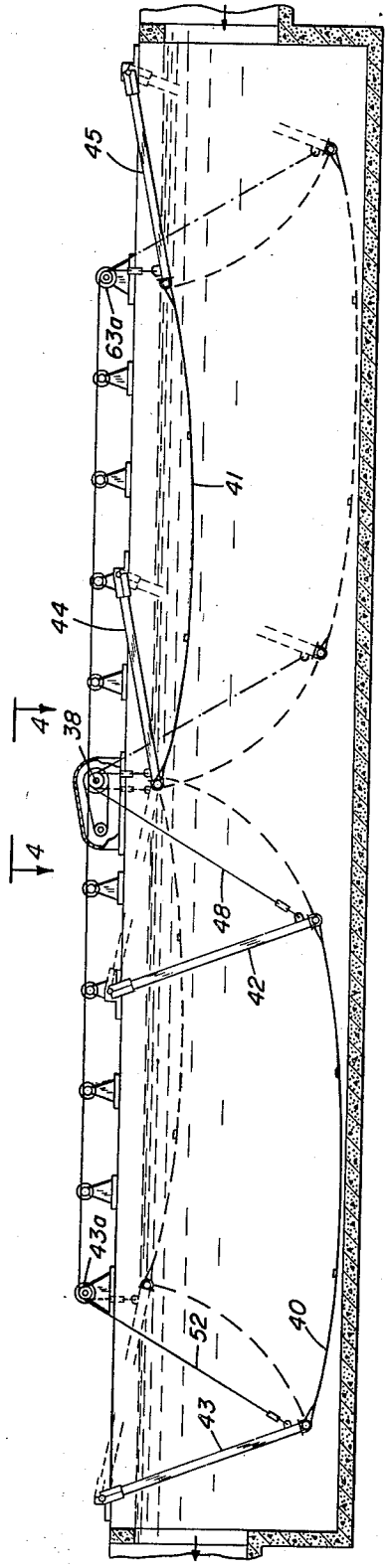

FIG. 3

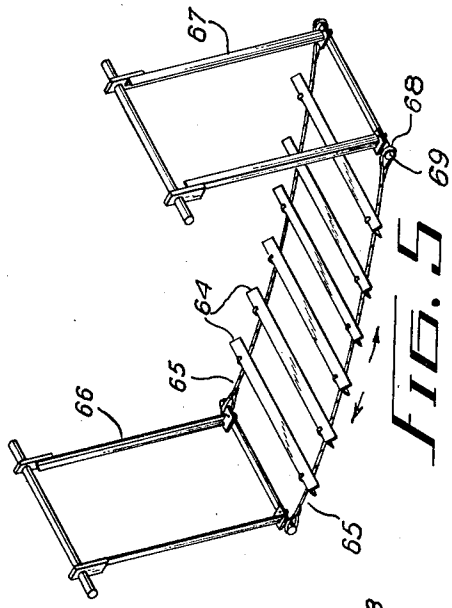

FIG. 5

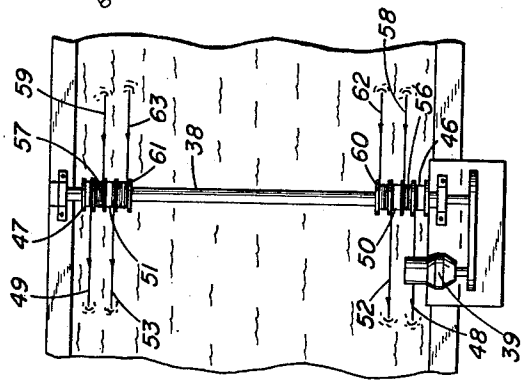

FIG. 4

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AGITATING APPARATUS FOR FLOCCULATING TREATMENT OF SUSPENSIONS

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Int. Cl. B01f 11/00
U.S. Cl. 259—100 4 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to the flocculating treatment of the suspension of solids or turbidity in liquids in a horizontal throughflow tank, by way of gentle agitation, and more particularly to improvements in the type of agitating mechanism wherein a horizontally extending flexible assembly of agitating means is endwise suspended in catenary fashion, and the assembly is moved up and down in a liquid body in the tank, featuring a parallel draft cable system.

The liquid or suspensions to be treated in the apparatus of this invention may, for example, comprise raw water, sewage, trade waste or any suspension wherein it is desired to flocculate these solids through the operation of a suitable agitating mechanism in a flocculating tank, with or without the aid of flocculating chemicals.

More particularly, this invention is concerned with improving the agitating mechanism that operates in a horizontal throughflow tank of the type disclosed in U.S. patent to Lindell No. 3,164,379. Improvements upon the apparatus of the Lindell patent are disclosed in the patent to Williamson et al. No. 3,389,892 of June 25, 1968.

Both Lindell and Williamson disclose agitating mechanism wherein a bank of ribbon elements are endwise suspended from a pair of swingable frames which move the ribbon elements up and down in the body of liquid in the tank, producing the desired type of agitation.

The Williamson application, in addition, discloses stress relief cable means inter-connecting the lower ends of these frame structures, which cable means are shorter than the catenaries of the agitator bands. A horizontal actuating shaft extending across the top of the tank has a draft cable attached to the lower end up one of the swinging frames in such a manner that rotating the shaft in one direction will swing this one frame structure upwardly while transmitting similar swinging movement through the stress relief cables to the other frame structure, thereby causing both frame structures to move substantially in synchronism while providing stress relief for the catenaries of the agitator bands and preserving a desired catenary shape. The length of the horizontal stress relief cables may be adjustable, whereby the shape or sag of the catenary is adjustable. Rotating of the shaft in the opposite direction will lower the assembly of agitating elements.

However, as these frame structures reach the end of their upward swinging movement, stress in the horizontal relief cables inter-connecting the frames reaches a maximum, possibly to the extent of several times the operating stress encountered during the initial part of the lifting movement. These peak stresses translate themselves into corresponding peak stresses in the bearings of the swinging frames.

One object of the invention is to provide efficient actuating mechanism for moving the frame structures in synchronism. This mechanism should provide stress relief for the flexible assembly of the agitating elements, without the need of the highly stressed horizontal relief cables, and should eliminate the peak pressures in the bearings by substituting uniformly low bearing pressures, even while

providing conveniently operable means for adjusting and determining the desired catenary shape.

The invention therefore lies in the provision of a draft cable system for motivating the swingable frames in synchronism from a single drive shaft rotatable alternatingly in opposite directions, wherein a first draft cable means leads from the single drive shaft to the first or adjacent supporting frame, while a second draft cable means operating in parallel to the first draft cable means leads from the shaft to the second or distant supporting frame. The effective length of each of these draft cable means may be variable, thereby rendering the catenary shape adjustable.

In one preferred embodiment, a single drive shaft actuates a pair of similar agitating apparatus, each featuring the above outlined draft cable system, in such a manner that movements of the one agitating apparatus is balanced relative to the movement of the other.

Other features and advantages will hereinafter appear.

As this invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, the present embodiment is therefore illustrative and not restrictive, since the scope of the invention is defined by the appended claims rather than by the description preceding them, and all changes that fall within the metes and bounds of the claims, or of forms that are their functional as well as conjointly cooperative equivalents, are therefore intended to be embraced by those claims.

FIG. 1 is a plan view of the flocculating apparatus embodying this invention, showing agitating elements of the ribbon type in a flexible assembly.

FIG. 2 is a longitudinal or sectional view of the apparatus, taken on line 2—2 of FIG. 1.

FIG. 3 shows the apparatus of FIG. 1 in duplex arrangement actuated from a common drive.

FIG. 4 is a partial plan view taken on line 4—4 of FIG. 3, showing the common drive shaft for the duplex arrangement.

FIG. 5 illustrates another type of flexible assembly of agitating elements adapted for use in this invention.

In the example herein shown to illustrate the invention, the agitating apparatus in the flocuulating tank resembles the one shown in the Williamson patent in respect to the use of a bank of parallel ribbons as agitating elements, but differs from that disclosure by the provision of separate draft cables for moving the swinging frame structures in synchronism directly from a common actuating shaft.

In the present example, the flocculating mechanism is installed in a horizontal throughflow treatment tank **10** of rectangular elongate shape having a flat bottom **11**, side walls **12** and **13**, influent end **14** and an effluent end **15**.

The flocculating apparatus itself in this example comprises a bank of parallel flexible agitator elements or bands **16** having loop-shaped terminals **17** and **18** whereby they are hingedly connected to the lower ends or transverse rods **18***a* of respective swingable supporting frames **19** and **20**.

Each of the agitator elements in this example may consist of a flexible band of stainless steel of very small thickness as compared to its width, for example, a band of material having a thickness of .010 to .020 inch and a width of perhaps 2 to 4 inches.

The swingable support frames depending into the liquid body in the tank are movable about parallel axes extending across the tank. Each support frame itself is a rigid structure swingable in a pair of bearings **21** and **22** mounted upon respective side walls of the tank. These frames may have transverse bars or slats **23** providing rigidity as well as agitation.

The actuating means for raising and lowering this assembly comprise an actuating shaft **28** parallel to the axes of frame **20**, and spaced a horizontal distance D–1 therefrom towards the adjacent end of the tank. The reversible drive motor **31** is operable to rotate the shaft alternatingly in opposite directions. This shaft is mounted in bearings **29** and **30**, and carries fixed thereon a pair of winding drums **26** and **27**. A first pair of parallel draft cables **24** and **25** connect the respective drums **27** and **26** with the lower end of the adjacent frame structure **20**. Means for adjusting the length of these draft cables may be provided in the form of turn buckles T.

Furthermore, fixed upon this drive shaft are a second pair of winding drums **26***a* and **27***a* to operate the second pair of draft cables **24***a* and **25***a* connected to the lower end of the distant frame structure **19**, which draft cables are guided over respective pulleys **32** and **33** mounted on a shaft **34** extending across the tank and parallel to the actuating shaft **28**. Additional guide means **35** may be provided for the horizontal portion of draft cables **24***a* and **25***a*. Again, the length of these longer draft cables may be adjusted as by turn buckles T.

It will be seen that the above described draft cable system applies identical lifting forces to the two support frames **19** and **20** in an equally uniform and efficient manner. It will also be seen that this draft cable arrangement is effective to maintain a desired catenary shape as defined by the amount of sag S.

In the embodiment of FIGS. 3 and 4, a drive shaft **38** rotated by a reversible motor **39**, actuates a pair of flexible assemblies of agitating elements **40** and **41** each being substantially similar to the one described above in FIGS. 1 and 2.

The first flexible assembly **40** is endwise supported by two swingable frames **42** and **43**, while the second assembly **41** is supported by two swinging frames **44** and **45**. In this duplex arrangement, the up-and-down movements of the two flexible assemblies are effectively interbalanced through the operation of the shaft, in a manner whereby the drive torque requirements are minimized.

Accordingly, for actuating the one assembly **40**, the shaft carries a pair of winding drums **46** and **47**, operating a pair of parallel drive cables **48** and **49** connected to the lower end of the adjacent frame structure **42**. Another pair of winding drums **50** and **51** on the shaft controls the winding and unwinding of another pair of parallel draft cables **52** and **53** connected to the lower end of the distant frame structure **43**, with pulleys **43***a* providing the required guidance. Rotation of the shaft alternatingly in both directions will raise or lower the assembly **40** due to the synchronized movements of the frame structures imparted thereto through the respective draft cables extending separately from shaft **38**.

The other flexible assembly **41** is endwise suspended from the swingable frame structures **44** and **45**. These frame structures are moved in synchronism due to the provision of a pair of winding drums **56** and **57** on the shaft, with parallel draft cables **58** and **59** connecting them to the lower end of the adjacent frame structure **44**. Another pair of winding drums **60** and **61** on the shaft operates parallel draft cables **62** and **63** connected to the lower end of the distant frame structure **45**, with pulleys **63***a* providing the required guidance for these cables. Rotation of shaft **38** will move the frame structure of this assembly in synchronism, thus raising and lowering the assembly **41**.

As seen from FIG. 3, rotation of the shaft is so controlled as to move the two assemblies **40** and **41** up and down in alternation, providing interbalance or weight compensation.

FIG. 5 illustrates another form of a flexible assembly of agitating elements which may be substituted for the bank of ribbon elements shown in FIGS. 1 and 2. In this example, the agitating elements proper are in the form

of rigid agitator bars or members **64**, arranged in parallel spaced relationship to one another. These agitator elements extend transversely of a pair of flexible linear supporting elements or ropes **65**, to which they are adjustably fastened as by suitable clamping devices or the like not shown. These supporting ropes in turn are endwise supported in catenary fashion from respective depending swingable frame structures **66** and **67** which may be similar to those shown and described above in connection with the embodiments of FIGS. 1 to 3. In this example the flexible assembly has a terminal loop **68** at each corner, which loops are readily attachable to, and detachable from pins **69** projecting laterally from the lower ends of the respective frames.

It will be understood that each of the elements or two or more together, of the apparatus herein described, may also find application in agitator mechanism other than the type described above.

Furthermore, while the invention has been illustrated and described as embodied in a flocculating agitating mechanism comprising a pair of swingable frames supporting a flexible assembly of agitating means, and draft cable means for moving the frames in synchronism, designed to minimize the catenary stresses in the flexible assembly, as well as other stresses resulting therefrom, it is not intended to be limited to the details shown, since various modifications and structural as well as functional changes may be made without departing from the spirit of the present invention.

I claim:

1. In a horizontal throughflow type of liquid treatment tank, an agitating apparatus which comprises a first frame structure mounted for swinging movement about a horizontal axis and extending from said axis into the liquid body in the tank,

a second frame structure mounted for swinging movement about a horizontal axis parallel to and horizontally spaced a substantial distance from said first horizontal axis and extending downwardly from its axis into the liquid body in the tank;

a flexible substantially horizontal assembly of agitating elements,

hinge devices connecting the ends of said assembly to respective frame structures at points located a substantial distance from the respective horizontal axes thereof, whereby said assembly is suspended in catenary fashion, and may be moved up and down when swinging said frame structures in unison,

a drive shaft parallel to the axes of said frame structures, and located outside the distance separating said axes, and spaced a horizontal distance away from the axis of said one frame structure in the direction of upward movement of said frame structures,

first draft cable means having one end connected to said shaft, and the other end connected to the one adjacent frame structure at a point spaced a substantial distance from the axis thereof,

second draft cable means having one end connected to said shaft, and the other end connected to the other frame structure in a manner similar to the connection of said first cable means to the first frame structure, said second and said first draft cable means being so constructed and arranged relative to each other and relative to the respective frame structures, as to establish a predetermined sag of said catenary shape, and so that rotating said shaft in one direction will swing said frame structures upwardly in unison to raise said assembly, while rotating of the shaft in the opposite direction will lower said frame structures and said assembly.

2. The apparatus according to claim **1**, wherein at least one of said draft cable means is provided with means for adjusting the effective length thereof.

3. The apparatus according to claim **1**, with the addition of a second agitating apparatus similar to the one defined in claim **1**, so arranged that all axes of all frame structures are parallel to one another and to said shaft, and wherein the draft cable means of said second agitating apparatus are connected to said shaft in such a manner that the movements of both said agitating apparatus are balanced with respect to each other.

4. The apparatus according to claim **3**, wherein said two agitating apparatus are disposed opposite each other, and said shaft is located intermediate said two apparatus.

References Cited

UNITED STATES PATENTS

3,015,476	1/1962	Stuart	259—100 X
3,164,379	1/1965	Lindell	259—100
3,389,892	6/1968	Williamson	259—100

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U.S. Cl. X.R.

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