

March 16, 1948.

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2,437,761

SEDIMENT RAKING MECHANISM FOR A SETTLING TANK COMPRISING
A CENTRAL SUPPORT AND A HINGED BODY BETWEEN THE
SUPPORT AND THE RAKING MECHANISM
Filed June 15, 1946

4 Sheets-Sheet 2

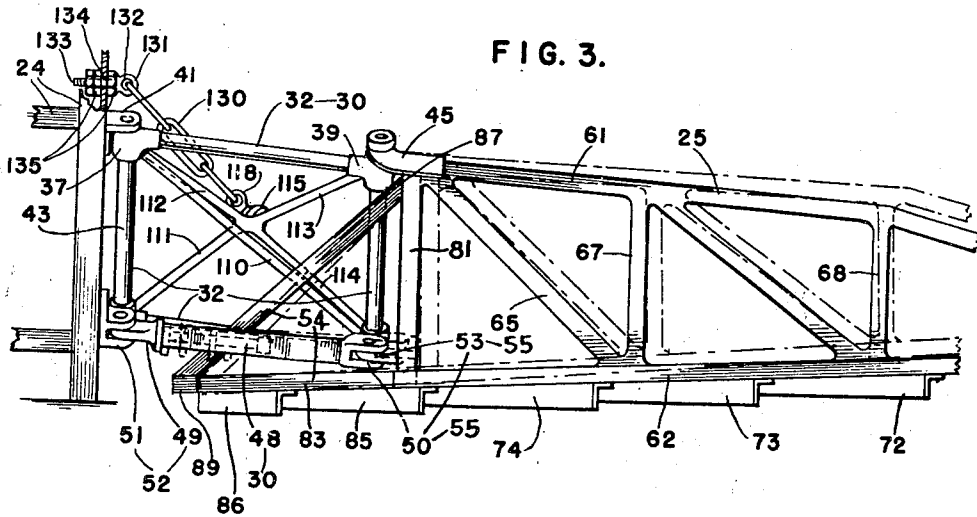


FIG. 3.

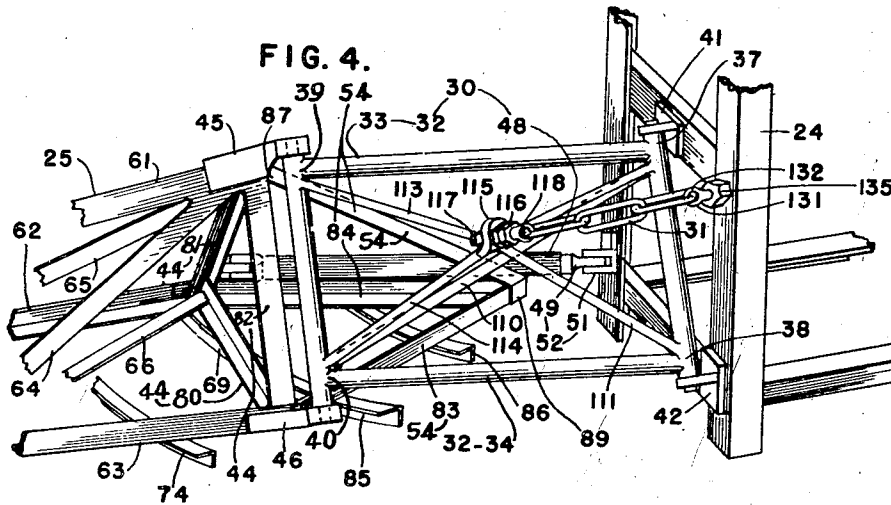


FIG. 4.

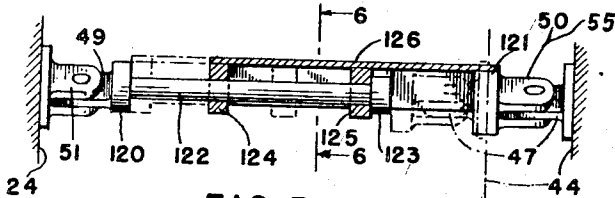


FIG. 5.

FIG. 6.
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4 Sheets-Sheet 3

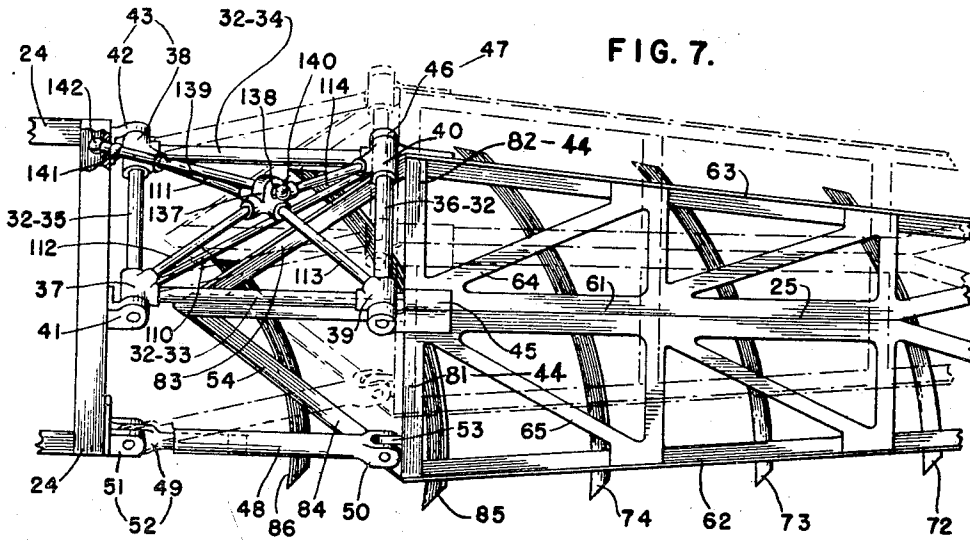


FIG. 7.

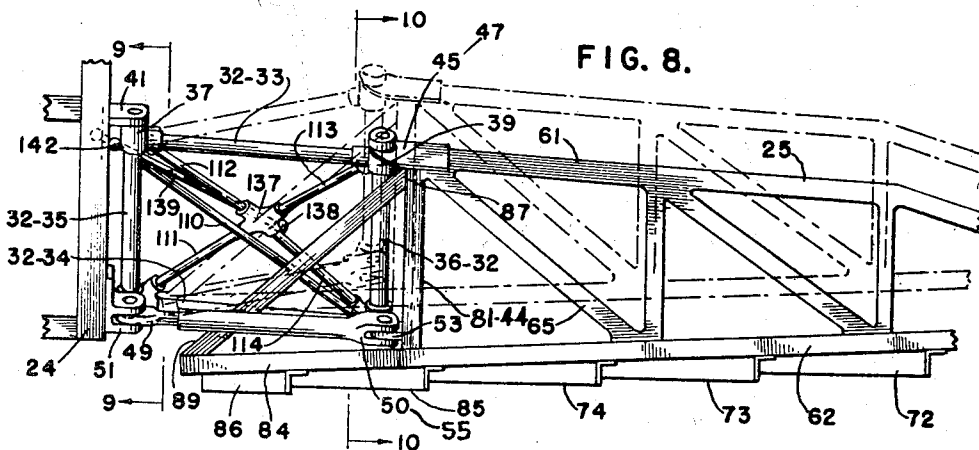


FIG. 8.

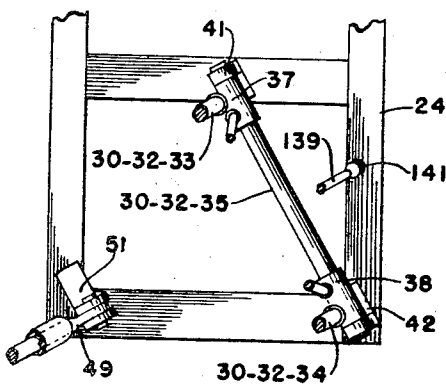


FIG. 9.

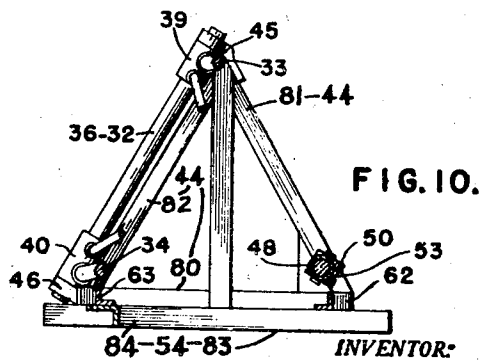


FIG. 10.

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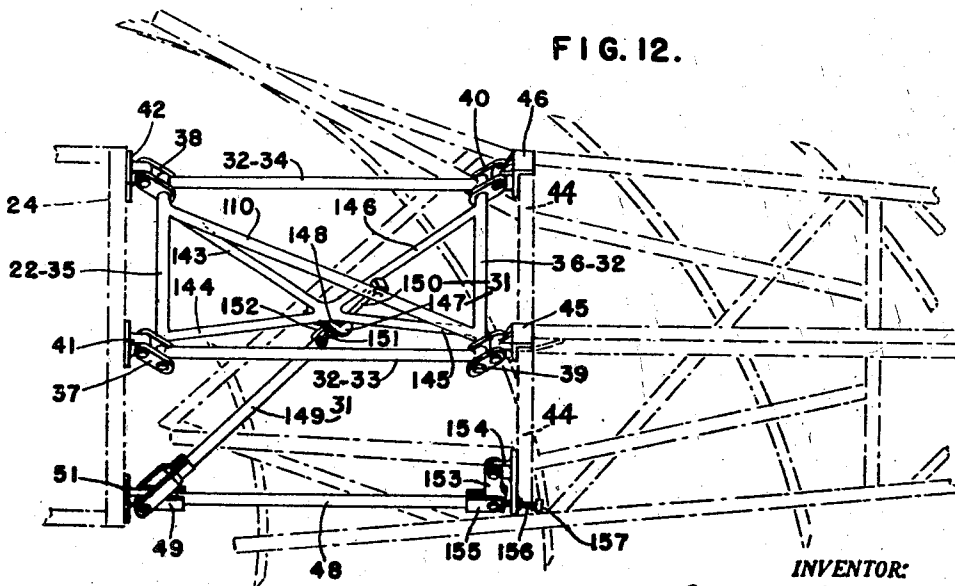
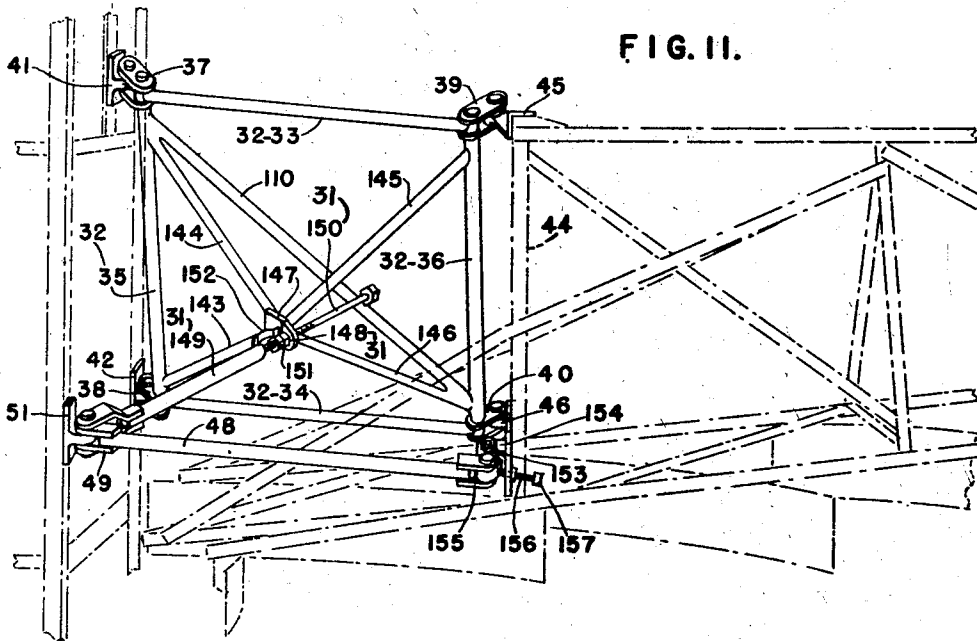
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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,437,761

SEDIMENT RAKING MECHANISM FOR A SETTLING TANK COMPRISING A CENTRAL SUPPORT AND A HINGED BODY BETWEEN THE SUPPORT AND THE RAKING MECHANISM

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Application June 15, 1946, Serial No. 677,004

12 Claims. (Cl. 210-55)

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The present invention relates to sedimentation apparatus having what is frequently referred to as a thickening or settling basin in which a sediment raking mechanism disposed over the tank bottom functions, incident to a horizontal turning movement about a vertically extending axis, to effect a raking or impelled transferring of sedimented material or settling solids to a discharge section usually disposed in, and generally provided by, a sump or depressed section located at or near the central portion of the floor of the tank or basin.

An apparatus of the general type to which the present invention is applicable or for which the invention hereof may be viewed as an improvement, is disclosed in my Patent No. 2,122,385 granted June 28, 1938. In that patent, there is shown a construction wherein a tank is equipped with raking mechanism having a centrally located support from which there is carried, and with respect to which there is movably mounted, a rake-arm carrier member or cage turnable about a vertically extending axis centrally located with respect to the tank and from which cage or carrier there extend outwardly therefrom rake arms preferably of built-up construction or skeleton type formation. Such arms are preferably made of rolled structural steel shapes which may be referred to as longitudinals, cross or diagonal bracing members as the case may be, and connecting plates therefor whereby relatively light weight but strong rake-arm structures are realized. From such rake-arm structure there downwardly extend sediment-raking elements disposed for functioning over and along the floor of the bottom of the tank in a manner of progressively impelled sedimented material to a sump preferably disposed at or in the vicinity of the floor of the tank. From this centrally disposed sump, the sedimented material collected and conveyed thereto is passed according to operative requirements either continuously or intermittently to regions outside of the tank either for disposal or for further treatment or utilization thereof.

In an apparatus of the type involved, influent with settleable solids therein is supplied for treatment or clarification, and clarified supernatant liquid is passed therefrom. There are times, for example, after a shut-down period when unusually deep sedimented deposits or other obstructions are encountered with the result that there becomes imposed an undue overload on the raking arms and raking mechanism as a whole.

In order to avoid or overcome undue loading on the rake arms and cage, or other support by

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which they are carried, the rake arms of said patent were mounted so as to permit for the outer ends of each of said arms a retarded swinging movement, so to speak, relative to the carrier therefor, to wit, whereby the outer ends could be rearwardly retarded and upwardly swung or moved about a downwardly and rearwardly inclined pintle axis of a single set of arm-carrying hinges or, as otherwise expressed, whereby the free or outer ends of the arms had a rearward and upward swinging movement relative to the cage or arm carrier, and this while the cage or arm carrier continues to turn in a general forward direction about its vertical axis.

Where the undue load is at the outer ends of the raking arms these retarded rearward and upward swinging movements of the arms are quite effective. However, if the overload or obstruction encountered is at the inner end portions of the arms or in the region immediately below the hinged sections of the arms, there is not realized any substantial releasing of the overload conditions since for such sections of the arms as supported by the hinge construction of said patent there is not any substantial rearward or upward movement of the inner end of the inner end portion of the rake arms from the floor or bottom of the tank.

The present invention has in view providing a construction where all parts of the rake-carrying arms can have rearward and upward movement, particularly if and when the obstruction or overload conditions are encountered because of undue loading at or near the central portion of the tank.

In order to accomplish the purpose of the present invention, for yieldably supporting each rake arm from a turnable cage or carrier thereof, there is inserted and employed a parallel motion mechanism embodying a double hinge construction having operatively associated therewith a hinged spacing strut as well as means for holding or supporting therefrom said mechanism and the rake arms when in a definite lowermost position therefor during normal operation but for permitting concurrent upward as well as rearward swinging movement of said mechanism with consequent bodily retardation and raising of the arms when overload conditions are experienced by the raking elements of the arms.

In the construction referred to, the double hinged member comprises an intermediate outwardly-extending hinge element or swinging hinge body of firm or rigid construction and of which the inner end is equipped with upper and

lower hinge leaves sometimes referred to as cage-carried hinge leaves since they are secured to the arm carrier or cage. These hinge leaves, when thus secured in place, are disposed with the pintle axes thereof in alignment as well as extending downwardly and rearwardly. The outer end of said intermediate hinge element is equipped with upper and lower hinge leaves sometimes referred to as arm-carrying hinge leaves, to which there is connected, so as to be carried thereby, a transversely-extending section of the raking arm whereby the rake arm may be viewed as yieldably supported so as to have rearward and upward bodily movement as and when the outer end of the intermediate hinged element swings upwardly and rearwardly, this because the hinged spacing strut heretofore referred to also becomes an important part of the parallel motion mechanism.

The strut member is located ahead of the swinging hinge body and one end of the strut, namely, the inner end thereof, is pivotally connected to a lowly disposed forward hinge leaf which is secured to the arm carrier or cage, while the other or outer end of the strut is pivotally connected to another hinge leaf which in turn is connected to a low forward portion of the aforementioned transversely extending hinge carried section of the raking arm. The pintle axes of the hinge leaves for this strut parallel the pintle axes of the hinge leaves for the intermediate hinge element or swinging hinge body. The functional length of the strut—when acting as a true strut—is equal, or substantially equal, to the length between the inner and outer pintle axes for the intermediate double hinged element referred to. In this preferred form of the invention, the strut member is of the telescopic construction and can be automatically extended to permit of retarded rearward and upward movements of the outer free end of a rake arm, should the latter encounter an abnormal overload primarily at the outer end thereof.

As above indicated, there is also provided a means for supporting the rake arm in lowermost position therefor preferably by supporting the rigid intermediate swinging hinge body. This end is attained by a supporting means interposed or provided between the turnable cage or carrier on the one hand and the swinging hinge body on the other. The last-mentioned means is sometimes referred to as a low limit stop means.

The invention hereof revolves about the conjoint employment of and arrangement of the double hinge, the strut, and the supporting means just referred to.

Because of the effective length required for the interposition of the parallel motion mechanism just referred to, it will also be noted that the transversely extending portion or hinge supported section of the arm which is connected to the outer ends of the double hinge and strut referred to, is spaced a corresponding distance from the turnable arm carrier. The rake arm is therefore provided with a rake-carrying section or inward extension that projects inwardly from and with respect to said transversely extending portion or hinge supported section just referred to.

This inward extension of the rake arms is also a novel feature of the invention hereof.

For rake arms as generally built, the raking elements thereof are provided by the depending raking blades spacedly arranged along the undersides of the arms and severally disposed so that the blades extend rearwardly and inwardly

with respect to the normal forward paths of travel thereof. The upward and rearward shift or bodily movement of each raking arm as a whole, consequent to encountering abnormal loads in raking conditions, effects not only the relieving of the raking load by lifting the arms, but also leads to a further advantageous effect by reducing the effective raking angle, particularly of the inner blades.

The novel features considered characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment when read in connection with the accompanying drawings in which:

Fig. 1 is a plan view of a sedimentation or thickener tank diagrammatically showing therein a sediment-raking mechanism by which the present invention is realized.

Fig. 2 is a sectional elevation of the tank and raking mechanism diagrammatically shown in Fig. 1.

Fig. 3 is a vertical front view showing at the left thereof part of a turnable rake arm carrier or cage, showing at the right end portion thereof a section of a rake arm and between the parts just mentioned a novel parallel-motion mechanism by which the rake arm is guidedly supported from the turnable carrier and a supporting or low limit stop means in the form of a flexible chain interposed between the turnable carrier and the parallel motion mechanism that functions for supporting the latter and thereby rake arm in the low limit supporting position therefor.

Fig. 4 is a rear elevational view of the construction shown in Fig. 3.

Fig. 5 is a longitudinal sectional view of a strut member constituting part of the parallel motion mechanism and which strut is a forwardly disposed member interposed between a lower front portion of the turnable carrier and a lower front portion of the rake arm. In this figure the strut is shown as having sliding or telescoping members and said members are in their extended position with respect to each other.

Fig. 6 is a cross sectional view taken on the line 6—6 of Fig. 5 looking in the direction of the arrows.

Fig. 7 is a plan view of a modified form of construction. In this figure there is included or shown at the left portion thereof a lower end section of the turnable carrier, at the right an inner end portion or section of the rake arm and interposed between the two a parallel motion mechanism and supporting a low limit stop means of a form modified as compared with the construction shown in Figs. 3 and 4.

Fig. 8 is a front elevational view of the parts shown in Fig. 7.

In Figs. 7 and 8 the full lines indicate the position of the rake arm and the yieldable carrying parts when in the lowermost and forward operating position therefor, while the dot and dash lines indicate the position of the rake arm and carrying parts when retardedly moved to the upper and rearward position therefor.

Fig. 9 is a vertical transverse sectional view taken as on the plane indicated by the line 9—9 of Fig. 8 looking in the direction of the arrows.

Fig. 10 is a vertical transverse sectional view

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taken as on the plane indicated by the line 10—10 of Fig. 8 looking in the direction of the arrows.

Figs. 11 and 12 are respectively vertical and plan views of another or modifying form of parallel motion mechanism and associated low-limit stop or supporting means which may be advantageously used in realizing the invention and for clarity in bringing out the construction and arrangement of the parts just referred to as they are shown in full line, while a portion of the turnable carrier at the left and a portion of the rake arm construction at the right are indicated by dot and dash lines.

Reference will now be made to the drawings in detail:

In the drawings 10 designates a settling tank suitable for use in a sedimentation unit of general application. Such tank is preferably cylindrical, or at least of a form devoid of sharp vertical corners and of a horizontal internal cross-section between that of a square as one limiting form and that of a circle as the other limiting form. The tank has a bottom 11 usually sloping downwardly at any desired angle to a central well or sump 12 for receiving sedimented solids passed thereto by the settled solids raking mechanism which functions within the tank. Connected to the section providing the central well or sump and leading from the bottom thereof, is a settled solids withdrawal pipe 13 providing a sediment discharge for the tank. Adjacent the top or upper portion of the tank 10 and extending along the periphery thereof, there is provided a trough 14 constituting an effluent launder which, with a discharge pipe 15 leading therefrom, constitutes a supernatant liquid withdrawal means. An upper edge portion of the trough or launder 14 provides a weir over which the supernatant liquid flows into the trough and this weir determines the normal operative level of the body of liquid undergoing sedimentation within the tank. Any suitable influent pipe or conduit constituting a tank feeding means can be employed and such conduit is designated by 16. In the construction shown this influent pipe is provided by a stationary pier 17 which is made hollow whereby the liquid solids mixture which is fed upwardly through the pier is delivered into the central section of the sedimentation tank and from which the liquid passes at a gradual and progressively decreasing flow rate to the marginal launder. This arrangement permits an early settling of readily settleable solids in the central regions of the tank and allows for a progressive settling of the less readily settleable solids as the liquid passes toward the marginal walls of the tank. It will be noted that in accordance with the quantity of liquid solids mixture fed into the tank through the feed pipe or conduit 16 there is a consequent and corresponding quantity of discharge of supernatant liquid into the trough and thence from the sedimentation unit. The pier 17 extends upwardly from the bottom of the tank and constitutes a support fixedly positioned with respect to the tank and is preferably centrally disposed with respect to the marginal wall 27 of the tank and the well or sump 12 is disposed adjacent to the base of this pier. The pier may be viewed as a stationary upstanding pedestal and it carries at the top thereof, a stationary bearing member 18 and an upward extension constituting a stationary platform 19. On the platform 19 there is mounted a motivating means provided as by an electric motor or other prime mover 20 and suitable speed reducing and power transmission

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mechanism collectively designated as 21 that is relied upon for imparting horizontal turning movement to the sediment raking mechanism hereinafter immediately referred to and described in detail.

The sediment raking mechanism, which is sometimes referred to as the settled solids raking assemblage, is collectively designated as 22 and comprises a turnable bearing member 23 mounted on the stationary bearing member 18 so as to rotate about a vertically extending axis concentric with the pier when driven by the motivating means 20. The turnable bearing member supports a depending arm-carrying structure or cage 24 from the lower portion of which there are indirectly carried rake arm constructions 25 embodying certain novel features heretofore mentioned. The depending arm-carrying structure is preferably provided by a framework or cage and surrounds the pier 17. The rake arm constructions are yieldably supported through the medium of parallel motion mechanisms collectively designated as 30 and associated low limit stop means collectively designated as 31 and functionable for yieldably supporting the rake arms at the normal lowermost positions therefor and positively against bodily movement below said normal operative positions. This low limit stop means derives support from said cage and in turn accords support to the parallel motion mechanism for the lowermost operative position therefor but permits upward movement when abnormal overload raking conditions are encountered by a rake-carrying arm, to wit, whereby the parallel motion mechanism can have upward and rearward swinging movement and also whereby any raking arm supported from said parallel motion mechanism can have upward and rearward bodily movement as a whole.

As to the parallel motion mechanism 30, this comprises outwardly-extending swingably mounted intermediate hinge body generally designated 32 of rigid frame construction embodying an outwardly-extending upper member 33, an outwardly-extending rear lower member 34, a downwardly and rearwardly extending inner end member 35 and a downwardly and rearwardly extending outer end member 36, all of which said members are firmly secured together to constitute important members of the rigid frame construction or swingable intermediate hinge body 32 referred to in the form of a parallelogrammatic rigid frame structure of which the upper and lower member may be referred to as longitudinal chord members, while the members 35 and 36 are referred to as sloping end members.

This intermediate hinge body has, at the inner or pivotal end thereof, vertically and horizontally spaced hinge elements, namely, an upper inner hinge element 37 and a lower rear inner hinge element 38 and at the outer swingable end thereof vertically and horizontally spaced hinge elements, namely, upper outer hinge element 39 and lower rear outer hinge element 40. The pintle axes of said inner hinge elements and of said outer hinge elements are parallel and when the swingable intermediate hinge body 32 is in place, said axes slope downwardly and rearwardly.

The turnable carrier or cage 24 has thereupon at the lower end portion thereof vertically and horizontally spaced hinge leaves, namely, an upper cage-carried hinge leaf 41 and a lower rear cage-carried hinge leaf 42, the pintle axes of which hinge leaves are aligned and extend downwardly and rearwardly. The cage-carried hinge

leaves 41 and 42 and the inner hinge elements 37 and 38 of the intermediate hinge body 32 complete an inner hinge construction sometimes referred to herein as inner hinge 43 by which the intermediate hinge body is swingably mounted so as to have yieldable upward and rearward swinging movements about the last-mentioned pintle axis, which axis may be referred to as the rear inner pintle axis.

Each rake arm 25 is supported through the medium of the swingable intermediate hinge body 32 corresponding thereto and embodies what may be referred to as a transversely-extending hinge-connected section 44—sometimes referred to as rake-arm carrier section—upon which there are mounted or to which there are secured outer arm-connected hinge leaves that are vertically and horizontally spaced, namely, an upper arm-connected hinge leaf 45 and a lower rear arm-connected hinge leaf 46. These hinge leaves 45 and 46 with the outer hinge elements 39 and 40 at the free end of the intermediate hinge body 32 referred to, complete an outer hinge construction—sometimes referred to herein as outer hinge 47 by which the rake arm corresponding thereto in turn derives support from the free end of the intermediate hinge body 32. In other words, the intermediate hinge body 32 constitutes a swingable carrying element interposed between and spacedly separating the turnable cage 24 on the one hand and the rake arm 25 on the other hand, which at the same time affords yieldable swingable support from the cage to the rake arm and in and for any and all positions of the latter.

As part of the parallel motion mechanism, reference has heretofore been made to the hinged strut or support or spacing member which is disposed between a lower forward portion of the cage 24 and a lower forward portion of the transversely-extending hinge connection section 44 of the arm. This strut is designated as 48 and is herein referred to as being forwardly and lowly located, to wit, in a region ahead of a lower portion of the intermediate hinge body 32. This strut has at the end thereof nearest the cage an inner hinge element 49 and at the outer or rake arm end thereof the outer hinge element 50. At and on the lower forward portion of the turnable carrier or cage 24 there is a low forwardly disposed carrier hinge leaf 51 upon which the inner hinge element 49 of the strut 48 is mounted whereby said hinge element 49 and said carrier hinge leaf 51 complete that which is sometimes referred to herein as the strut inner hinge 52, or as otherwise viewed, as a hinge construction provided between the cage 24 and the inner end of the strut 48. The pintle axis of said strut inner hinge 52 parallels the pintle axes heretofore referred to. The pintle axis for said strut inner hinge 52 may be viewed and referred to as a forward inner pintle axis.

At the forward lower portion of the transversely-extending hinge carried section 44 of the arm, there is mounted an arm-carried strut supporting member or hinge leaf 53 by which the outer end of the hinged strut 48 is carried or connected whereby the strut normally functions under compression and is held in place and in position with respect to the swingably mounted intermediate hinge body 32, namely, in a manner whereby there is completed a parallel motion mechanism generally designated 30. The functionable normal swinging or radial length of the hinge strut 48 is

that of the effective swinging or radial length of the intermediate hinge body 32.

The parts thus described and referred to are all diagrammatically indicated, and so numbered in Figs. 1 and 2. The same numbering for like functioning parts is applied to the different modified forms of the invention as shown in the several figures hereof. This mode of applying certain of the general reference characters has been adopted since it readily adapts itself to a clear indication as to how the different forms of parallel motion mechanisms 30 and of the low limit stop means 31 can be employed between the cage 24 on the one hand and the particular rake-arm construction 25 on the other hand.

Also in connection with the foregoing, it will be noted that for each rake arm 25 shown, there is an inward extension generally designated 54 of that which may be viewed as lower longitudinals or rake stringers and from which stringers depending and angularly disposed rake elements are supported. That portion of the arm construction extends inwardly with respect to the region whereat the transversely-extending hinge-connected or hinge carried section 44 of the rake arm 25 is located. In other words, the rearwardly extending rake-carrying section 44 enters and functions within the regions below the swingable intermediate hinge body 32 and the hinge strut 48. This rearward extension 54 is indicated diagrammatically in the showing of Figs. 1 and 2, but is more clearly shown and indicated in and by the forms illustrated in the other figures.

For the purpose of this case apparatus as shown in Figs. 1 and 2 may be viewed as shown more in detail in Figs. 3 to 6 inclusive. In each of the forms illustrated, namely, Form 1, as illustrated diagrammatically in Figs. 1 and 2 and in greater detail by Figs. 3 to 6 inclusive; Form 2 as illustrated by Figs. 7 to 10 inclusive, or Form 3 as illustrated by Figs. 11 and 12, there is indicated as by full lines in connection with Forms 1 and 2 and by dot and dash lines in Form 3, the lower part of the arm-carrying structure or cage 24 and also in a like manner the inner portion of rake-carrying arms 25 or rake arms as they are frequently referred to.

In respect to each of said forms the parallel motion mechanism generally designated 30 and the low limit stop mechanism generally designated 31 are shown by full lines. The parallel motion mechanism 30 of each form and the low limit stop mechanism 31 of each form will subsequently be described in detail.

As to the turnable arm-carrying structure or cage 24 of which only a lower portion is indicated or shown with respect to said three forms by the showing of said Figs. 3 to 12 inclusive, it will be noted that the construction of said turnable cage or arm carrier 24 and mode of supporting the same is well known and that detailed description thereof would be superfluous if presented herein. For example, the turnable arm supporting structure, cage or carrier, as it sometimes is called, may be of the type shown in my Patent No. 2,122,384 entitled Sedimentation apparatus granted June 28, 1938.

As to the rake-carrying arms or rake arms 25, as they are frequently referred to, each is generally made up of rolled structural shapes or strips suitably connected as by welding or by other suitable connecting means and each includes firmly united into a structural whole, members such as upper longitudinal 61, lower front longitudinal 62, lower rear longitudinal 63,

diagonals such as 64, 65 and 66 and cross braces 67 and 68. From the arm structure thus provided there are carried so as to depend therefrom raking blades such as 69, 70, 71, etc. which are longitudinally or radially spaced and of which the raking faces thereof extend inwardly and rearwardly with respect to the forward paths of movement therefor. Each of such arms preferably embodies the transversely extending hinge connected section 44 heretofore referred to and which is provided by such members as lower transverse member 80 upwardly and rearwardly inclined front transverse member 81 and upwardly and forwardly inclined rear transverse member 82 that complete a vertically and transversely triangular structural formation. Inwardly disposed with respect to said thus provided transverse hinge connected section 44, there is also formed and provided the inwardly extending section 54 of the rake arm which has heretofore been referred to. This inward extension of the rake arm, to wit, the section that extends inwardly from the locality and general region whereat the rake arm is hingeably supported, is believed to be basically new.

In each rake-arm construction 25 as shown by forms 1 and 2, this inward extension 54 embodies or is provided by relatively horizontal or inwardly extending portions or members typified by converging members such as 83 and 84 from which there depend raking blades such as 85 and 86. This inwardly extending section 54 is also preferably provided with inwardly and downwardly extending bracing means or tension members disposed between the upper portion 87 of the transversely-extending hinge connection 44 and the innermost locality 89 whereat said converging members 83 and 84 either meet or approach each other.

Except as indicated or expressed herein the structure of the rake arms in general follow the basic teachings already outlined in or by my aforementioned Patents Nos. 2,122,384 and 2,122,385.

As to the parallel motion mechanism 30 and low limit stop means 31 of the three forms mentioned, each is now described in detail.

Form 1—Figs. 3 to 6 inclusive

With respect to these figures it will be noted that Fig. 3 is a front view while Fig. 4 is a rear view showing a lower portion of the turnable arm-carrying structure 24, the inner end of the rake-arm construction 25, the parallel motion mechanism interposed between the carrier 24 and the arm 25 and the low limit stop means generally designated 31 and with respect to the parallel motion mechanism 30 referred to, it embodies the swingable rigid intermediate hinge body generally designated 32 and the functionally associated hinge compression strut 48, all of which have heretofore been referred to in the preceding general description.

Respecting the intermediate hinge body generally designated as 32, this has heretofore been described as having outwardly-extending upper and rear lower members 33 and 34 which may be referred to respectively as upper and lower chord members 33 and 34 and as having downwardly and rearwardly extending inner and outer end members 35 and 36. All of the members just referred to are rigidly connected to form a parallelogrammatic main frame. The intermediate hinge body of Figs. 3 to 6 also includes a diagonally disposed tension member 110 connected in place and

extending downwardly from the upper inner corner of the main frame to the lower outer corner thereof and provided for adding strength and rigidity thereto because of the arm load carried at and from the outer end of the main frame. Also in order to provide for rigidity against torsional or twisting strains which may be imposed upon the intermediate hinge body, there is introduced and employed as part thereof a rearwardly extending anti-twisting truss shaped bracing provided by diagonally-extending elements or members 111, 112, 113 and 114 the outer ends of which are connected at the corners of said main frame and converge from said corners to a connecting or general meeting region inwardly disposed with respect to the parallelogrammatic main frame, and at which general meeting or converging locality they are severally connected by or to a common connecting member 115 having an apertured opening 116 for receiving the threaded end 117 of an eyebolt 118 constituting a part of the low limit stop means 31.

The inner end of the intermediate hinge body constructed as above described is swingably supported from the turnable arm carrying structure or cage 24 through the medium of the inner hinge 43 which is provided by the upper and rear lower cage-carried hinge leaves 41 and 42 and the upper and rear lower hinge elements 37 and 38 provided on or at the inner end of the intermediate hinge body 32. At and for the outer end of the intermediate hinge body there is carried the rake arm structure 25 which is supported in place through the medium of the outer hinge 47 which is provided by the outer upper and rear lower hinge elements 39 and 40 on the body and by the upper and rear lower arm carried hinge leaves 45 and 46, the latter of which are connected to the transversely-extending hinge carried section 44 of the rake arm 25.

As to the hinge strut generally designated as 48 the inner end thereof is supported from the turnable arm-carrying structure or cage through the medium of a strut inner hinge 52 provided by a cage-carried hinge leaf 51 and an inner hinge element 49 at the inner end of the strut. The outer end of the strut is connected to the forward lower portion of the transversely-extending hinge carried section 44 through the medium of an outer strut hinge 55 embodying or provided by an outer hinge element 50 on the strut and an arm connected hinge leaf 53 at the forward lower end of the transversely-extending hinge connected section 44.

As to the strut this normally functions in compression and in a non-extended position for the members thereof, to wit, as shown in Fig. 3. This strut, however, embodies slidably-connected body members such as 120 and 121 having end portions affording the inner hinge element 49 and the outer hinge element 50. The members 120 and 121 constitute slidably-connected body members which are shown in an extended position relative to each other in Fig. 5. With respect to this strut, it will be noted that the number 120 has a sliding-rod portion 122 with an outer end enlargement or abutment 123 thereupon. This rod portion 122 is slidably mounted in apertured members 124 and 125 which extend inwardly and downwardly from an angle-shaped portion 126 constituting a part of the slidable member 121 heretofore referred to. The arrangement of the rod portion 122 with respect to the triangular-shaped body portion 126 is readily apparent from an inspection of Fig. 6.

While this strut 48 thus provided, normally functions in compression, nevertheless as the body members 121 and 122 slidably move to extended positions thereof there is permitted a retarded rearward and upward swinging movement for the outer end of the rake-carrying arm 25 corresponding thereto, to wit, a swinging movement about the downwardly and rearwardly extending pintle axis at the outer end of the intermediate hinge body 32 at a time when an abnormal overload raking condition is experienced at and by the outer end of the rake-carrying arm.

The arrangement of the parts shown is such that if a raking overload condition is experienced primarily at the inner portion of the raking arm, there can follow a retarded rearward and upward bodily swinging movement of the entire rake arm 25 due to its support through the medium of said intermediate hinged body because of the swinging movement thereof about the downwardly and rearwardly extending inner pintle axis and under these conditions the strut continues to operate as a member under compression but if and when the overload encountered is abnormally heavy at the outer end of the rake arm there can also follow the swinging movement of the rake arm as previously described about said outer pintle axis.

Respecting the low limit stop means 31 of Form 1, it will be noted that this is provided by a chain or other flexible member 130 the upper end of which is connected to an apertured portion 131 of an eyebolt 132 the threaded end section 133 of which is secured in place to an apertured portion 134 of the turnable arm-carrying structure 24 through the medium of nuts 135 whereby the eyebolt can be fixedly held in adjusted position therefor for regulating or determining the effective length of the low limit stop means 31 as a whole. This chain or flexible member 130 when in position as shown in Figs. 3 and 4 extends from its connection on and to the turnable arm carrier downwardly and forwardly to the apertured section of the eyebolt 118 heretofore described as being located on the apertured connecting member 115 at the rear side of the rearwardly disposed anti-twisting truss frame heretofore referred to. By adjusting the effective length of this low limit stop mechanism, to wit, by adjusting the position of either eyebolts 115 or 132 relative to the part to which it is connected, one can readily adjust the lowermost position which the rake arm as a whole can assume.

Form 2—Figs. 7 to 10 inclusive

The construction and arrangement of all parts of this form of apparatus are substantially the same as for the parts of Form 1 except for a slight change respecting the construction and mode of mounting of the low limit stop mechanism.

In this form of swingable intermediate hinge body 32 the rearwardly extending anti-twisting truss bracing is employed. However, in and for the connecting element or member provided at and for the converging ends of the diagonal elements 111, 112, 113 and 114 there is an apertured member 137 having an opening for receiving the lower outer end 138 of a tension rod 139 having a supporting abutment member or enlarged stop 140 at the lower end thereof which when the low limit tension means is functioning as such serves as stop member upon which the apertured connection member 137 has supporting engagement but relative to which rod 139 said apertured member 137 can have sliding engage-

ment consequent to a rearward upward swinging movement of the intermediate hinge body 32. The upper rear end of said tension rod 139 is mounted in an apertured portion or member 141 provided at or on the turnable carrying structure 24. The upper end of the rod 139 also has an enlargement or supported abutment 142 therefor which engages the apertured member or portion 141 just referred to. This tension rod 139, which is thus supported from the turnable carrying structure 24, extends downwardly and forwardly from its place of support into and through the apertured connecting member 137 on the swingable intermediate body 32 and functions in substantially the same manner as the flexible chain 130 of the low limit stop mechanism of Form 1.

Form 3—Figs. 11 and 12

The general construction of the intermediate hinge body 32 for this form follows the general teaching of and for the intermediate hinge body of Forms 1 and 2. With an exception respecting the anti-twisting or anti-torsional bracing construction which instead of being located on or at the rear of the parallelogrammatic frame as in the case of Forms 1 and 2, the anti-twisting truss frame bracing in Form 3 the diagonal extending bracing elements, namely, 143, 144, 145 and 146 are connected at the outer end of the corner sections of the parallelogrammatic frame but extend forwardly with respect to said frame and are severally connected at and to a forwardly disposed connecting element 147 having apertures 148 provided for receiving the upper end of an upwardly and inwardly hinged tubular body 149 from which there also projects an upwardly and rearwardly threaded rod 150 having stop nuts 151 thereupon. The hinged tubular body 149 is carried from a lower forward portion of the turnable arm-carrying structure through the medium of suitable hinge means provided therefor. The threaded rod 150 is slidably mounted in and extends through the apertures 148 of the connecting element 147 and the latter rests upon the stop nuts 151 when the rake arm 25 is stopped and held in the lowermost operative position therefor. The stop nuts 151 are positionable and adjusted for supporting the intermediate hinge body 32 and the arm 25 carried therefrom when the nuts are adjusted for the lowermost or arm-supporting position therefor are fixedly secured in place relative to the rod and to the swingable or hinged tubular member or body 149 through the medium of a strip of metal 152 which is weldedly connected at one end to the nuts 151 at the other end thereof to the tubular member 149.

From the description just given and from the inspection of the drawings, it will be seen that the low limit stop means of this form and generally designated 31 embodies the hingeably supported tubular member 149, the threaded rod extension 150 with nuts 151 thereupon, and the apertured connecting element 147 at the end of the inwardly and forwardly extending diagonals 143, 144, 145 and 146 and that the low limit stop means thus provided supports the intermediate hinge body and therethrough the rake-arm structure 25 carried in a manner whereby the main members of this low limit stop means are under compression in contradistinction to the tension support members provided by the flexible chain 130 of Form 1 or by the tension rod 139 of Form 2.

Also in this Form 3 the compression strut generally designated 48 is provided at its outer end

with a swinging link 153 of which one end is pivotally mounted on an arm carried hinge element 154 and of which the other end is pivotally connected to an outer strut hinge element 155. This link is provided to permit of a retarded rearward and upward swinging movement of the arm with respect to the outer rearwardly and downwardly extending pintle axis at the outer swinging end of the intermediate hinge body 32 should the outer end of the rake arm encounter an abnormal overload in the outer region thereof. In this manner there is realized a compression strut 48 that functions in a manner equivalent to that of a telescoping body of the Form 1 as shown in Figs. 5 and 6.

In this Form 3, there is also provided at the lower forward portion of the hinge connected section 44 an apertured portion for receiving the threaded end 156 of what may be viewed as the threaded bolt 157 so disposed that the inner end of said bolt functions as an adjustable abutment stop for engaging the outer end of the compression strut 48 whereby the latter will operate as a compression member during the normal operation of the apparatus. This bolt 157 which thus functions as an abutment or adjustable stop can be positioned whereby to regulate the general slope or position of the rake arm 25 with respect to the intermediate hinge body 32 from which it is carried. From the above it will be observed that the parallel motion mechanism and the low limit stop means of Form 3 follow the general teachings of Forms 1 and 2 except for the structural changes indicated.

From that which has preceded, it will be manifest how the different forms of apparatus operate and function when in use and it is believed that further description in this regard is unnecessary.

What is claimed is:

1. A sedimentation unit comprising a tank having a bottom with a depressed portion providing a sediment-receiving sump in the central portion thereof, a marginal wall rising from said bottom, means for supplying liquid mixture to the tank, supernatant liquid withdrawal means leading from the upper portion of the tank, a sediment-discharge leading from said sump and in operative association with the foregoing a sediment raking mechanism having supporting means fixedly positioned with respect to the tank; a main bearing member supported from said supporting means; a movable bearing member mounted on said main bearing member and turnable about a vertically-extending axial line centrally disposed with respect to the marginal wall of the tank; a vertically-extending main carrier supported by said movable bearing member and turnable therewith; means for turning said movable bearing member and said main carrier in a forward direction about said vertically-extending axis; certain yieldably supported rake-carrying arms extending outwardly with respect to said axis equipped with sediment engaging and impeller elements extending downwardly therefrom and each having a hinge connected section; means for yieldably supporting said certain rake-carrying arms from said turnable main carrier and characterized in that there is included for each yieldably supported rake-carrying arm an outwardly-extending intermediate hinge body of rigid construction, an inner hinge between the turnable main carrier and the inner end portion of said intermediate hinge body whereby the latter is swingably supported from said turnable main carrier, an outer hinge between the swing-

ing end of said intermediate hinge body and the hinge connected section of the arm whereby the latter in turn is carried from the swingable end of said intermediate hinge body, the pintle axes of said inner and outer hinges sloping downwardly and rearwardly with respect to the horizontal paths of the forward turning movement thereof, a compression strut disposed in advance of the lower portion of said intermediate hinge body and hingeably connected at one end of the turnable main carrier and at the other end to the rake-carrying arm whereby the means comprising said intermediate hinge body and the means comprising said strut complete a swingable supporting mechanism; and low limit stop means between the turnable main carrier and a swingably supported member affording support to the rake-carrying arm in a lowermost operative position therefor with respect to the floor of the tank but in a manner to permit a rising of the rake-carrying arm when an abnormal raking load is imposed upon the latter.

2. A sedimentation unit according to claim 1, wherein the compression strut disposed between the turnable main carrier and the rake-carrying arm is so constructed and mounted that when the rake-carrying arm encounters an abnormal raking overload condition at the outer end thereof said outer end is free to have a swinging movement rearwardly and upwardly with respect to the intermediate hinge body from the outer end of which the arm is swingably supported.

3. A sedimentation unit according to claim 1, and in which a swinging movement of the rake-carrying arm with respect to the intermediate hinge body about the pintle axis of the outer hinge of said body is free to take place when an abnormal raking overload condition is encountered at the outer end of the arm and from a position at which the strut continues in compression;

4. A sedimentation unit according to claim 1, in which there is an extension of the rake arm inwardly with respect to the locality whereat the outer end of the intermediate hinge body has hinge connection with the arm.

5. A sedimentation unit comprising a tank having a bottom with a depressed portion providing a sediment-receiving sump in the central portion thereof, a marginal wall rising from said bottom, means for supplying liquid mixture to the tank, supernatant liquid withdrawal means leading from the upper portion of the tank, a sediment-discharge leading from said sump and in operative association with the foregoing a sediment raking mechanism having a support fixedly positioned with respect to the tank; a main bearing member carried from said support; a movable bearing member mounted on said main bearing member and turnable about a vertically-extending axial line centrally disposed with respect to the marginal wall of the tank; a vertically-extending main carrier supported by said movable bearing member and turnable therewith; means for turning said movable bearing member and said main carrier in a forward direction about said vertically-extending axis; certain yieldably-supported rake-carrying arms extending outwardly with respect to said axis equipped with sediment engaging and impeller elements extending downwardly therefrom and having transversely-extending hinge connected sections; means for yieldably supporting said rake-carrying arms from said turnable main carrier member and characterized in that there is included

for each yieldably-supported rake-carrying arm an outwardly-extending intermediate hinge body of rigid construction, an inner hinge between the turnable main carrier and the inner end portion of said intermediate hinge body whereby the latter is swingably supported from said turnable main carrier, an outer hinge between the swinging end of said intermediate hinge body and the transversely-extending hinge connected section of the arm whereby the latter in turn is carried from the swingable end of said intermediate hinge body, the pintle axes of said inner and outer hinges being parallel and having downward and rearward slopes with respect to the horizontal paths of the forward turning movement therefor, a compression strut disposed in advance of the lower portion of said intermediate hinge body and hingeably connected at one end of the turnable main carrier and at the other end to the transversely-extending hinge connected section of the rake-carrying arm whereby the means comprising said intermediate hinge body and the means comprising said strut complete a parallel motion mechanism, and means extending between the turnable main carrier on the one hand and the swingable outwardly-extending rigid intermediate hinge body on the other for supporting the latter in the lowermost position therefor whereby to indirectly support the rake-carrying arm extending therefrom at a distance above the floor but in a manner to permit a rising of the rake-carrying arm when an abnormal raking load is imposed upon the latter.

6. A sedimentation unit according to claim 5, in which the strut comprises body parts slidable relative to each other whereby said body parts can move from a contracted position occupied by them when the strut functions under compression to an extended position relative to each other whereby to permit an upward and rearward swinging movement for the outer end of the rake-carrying arm upon an abnormal overload raking condition being encountered at the outer end of said arm.

7. A sedimentation unit according to claim 5 and in which there is a section of the rake-carrying arm with rake elements depending therefrom and which section extends inwardly with respect to the transversely-extending hinge connected section of the arm.

8. A sediment raking assemblage for employment in a settling tank having a stationary supporting means, which raking assemblage comprises in combination an arm-carrying structure adapted for unidirectional turning movement about a vertically-extending axis when mounted upon the stationary supporting means and outwardly-extending rake arms effective during forward turning movement thereof for raking and transferring sedimented material from diverse sections of the bottom of the tank to a sediment discharge section in a region proximate that in which the arm-carrying structure moves; said raking assemblage being characterized in that each of certain of said rake arms is yieldably supported from the turnable arm-carrying structure through the medium of a mechanism comprising a double hinge construction embodying a swingable outwardly-extending intermediate hinge body, an inner hinge supported from the turnable arm-carrying structure and in turn connected to the inner end of the intermediate hinge body for swingably supporting the latter; an outer hinge supported from the outer swing-

able end of the intermediate hinge body and in turn connected to a transversely-extending hinge-carried section of the rake arm for supporting the latter; the pintle axes of which inner and outer hinges slope downwardly and rearwardly; a compression strut disposed between and having pivotal connection with the arm-carrying structure on the one hand and the rake arm on the other; and a low limit stop means interposed between the turnable arm-carrying structure and a member mounted upon and swingable with the aforementioned double hinge construction and which low limit stop functions whereby the lowermost raking position of the rake arm is determined by the low limit stop means but which permits retarded rearward and upward bodily movement of the rake arm relative to the turnable arm-carrying structure upon abnormal overload raking conditions being encountered by the rake arm.

9. A sediment raking assemblage for employment in a settling tank having a stationary supporting means, which raking assemblage comprises in combination an arm-carrying structure adapted for unidirectional turning movement about a vertically-extending axis when mounted upon the stationary supporting means and outwardly-extending rake arms effective during forward turning movement thereof for raking and transferring sedimented material from diverse sections of the bottom of the tank to a sediment discharge section in a region proximate that in which the arm-carrying structure moves; said raking assemblage being characterized in that each of certain of said rake arms is yieldably supported from the turnable arm-carrying structure through the medium of a mechanism comprising a double hinge construction embodying a swingable outwardly-extending rigid intermediate hinge body, an inner hinge supported from the turnable arm-carrying structure and in turn supporting the inner end of the intermediate hinge body for swingably supporting the latter; an outer hinge supported from the outer swingable end of the intermediate hinge body and in turn connected to a transversely-extending hinge-carried section of the rake arm for supporting the latter; the pintle axes of which inner and outer hinges are parallel and slope downwardly and rearwardly; a compression strut disposed between and having pivotal connection with the arm-carrying structure on the one hand and the rake arm on the other; and a low limit stop means interposed between the turnable arm-carrying structure and a portion of the swingable outwardly-extending rigid intermediate hinge body on the other hand.

10. A sediment raking assemblage according to claim 9, wherein the rake arm has a raking section extending inwardly from and with respect to the transversely-extending hinge carried section.

11. A sediment raking assemblage according to claim 9, wherein the strut is extendable from a contracted compression resisting position therefor.

12. A sediment raking assemblage according to claim 9, wherein the rigid intermediate hinge body is in the form of a skeleton framework comprising rigidly connected upper and lower, and inner and outer end members, also rigidly connected thereto diagonal bracing members connected to form a crown-shaped member and according to which a portion of the low limit stop

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means has cooperative engagement with a portion of the crown-shaped member.

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