Feb. 12, 1952 F. L. GRANER ET AL 2,585,006

SEDIMENTATION UNIT

Filed Jan. 29, 1947 4 Sheets-Sheet 1

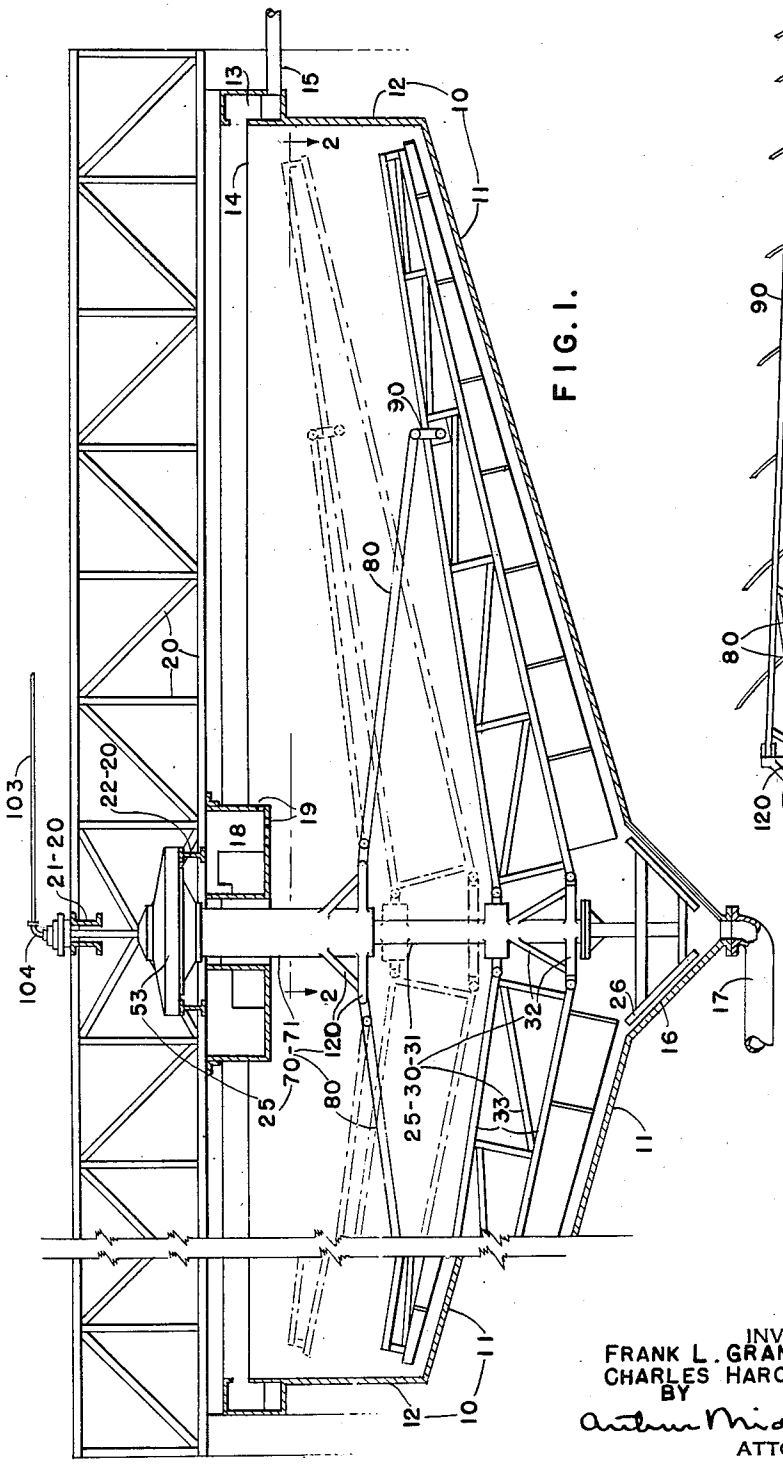



FIG. 1.

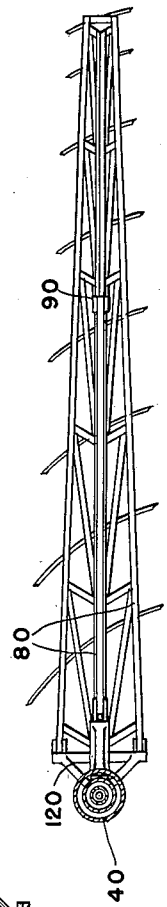



FIG. 2.

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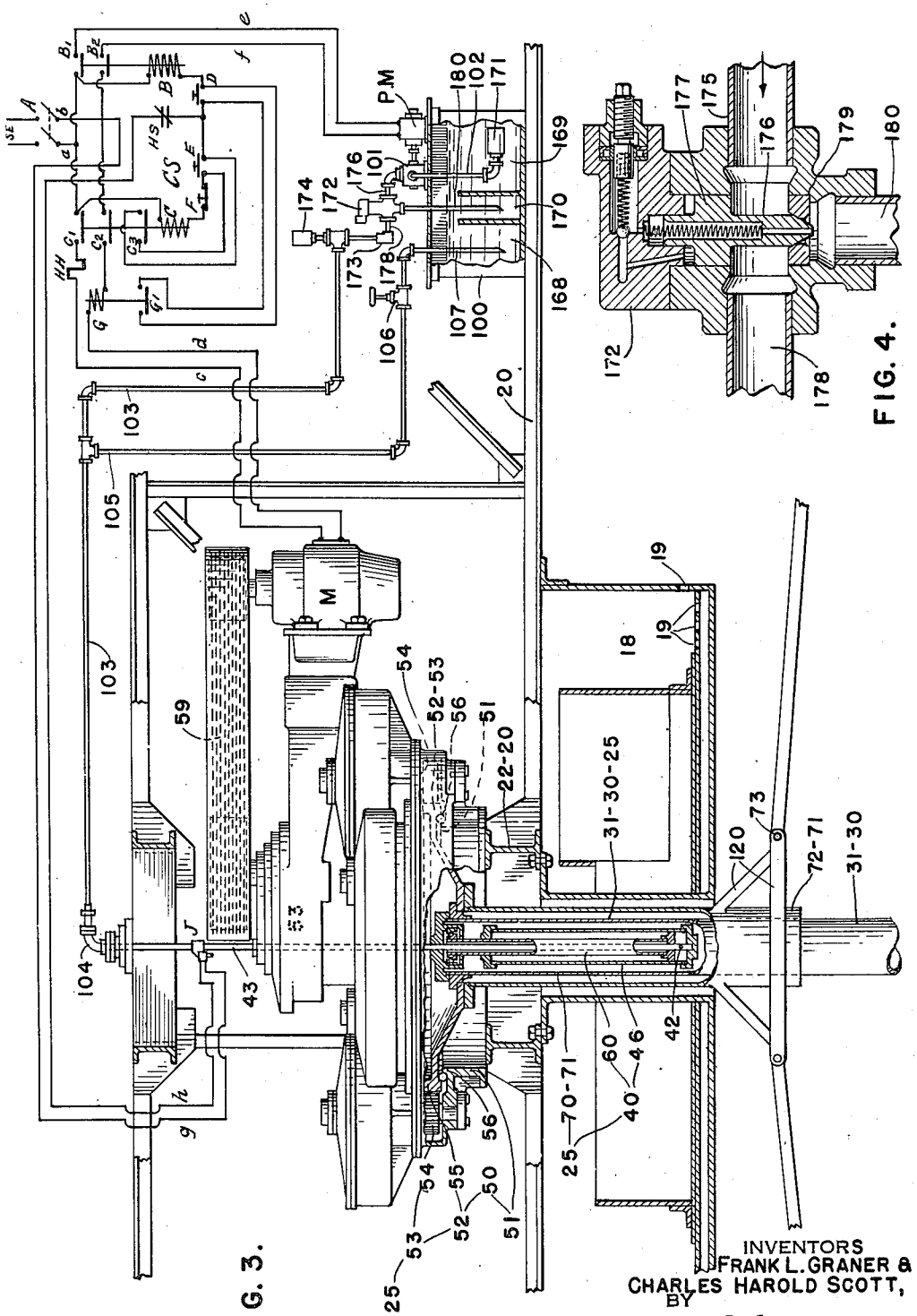



FIG. 4.

FIG. 3.

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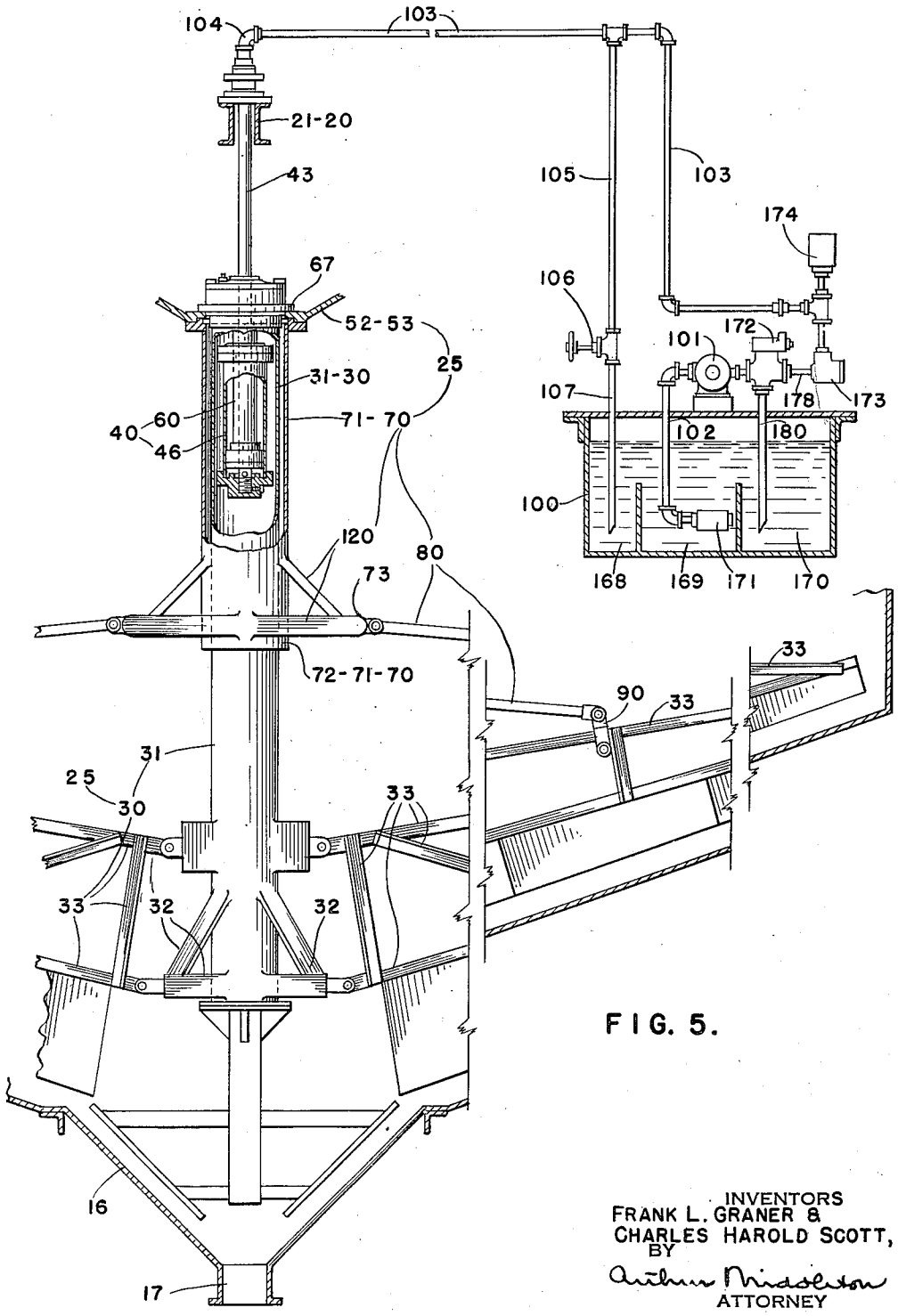



FIG. 5.

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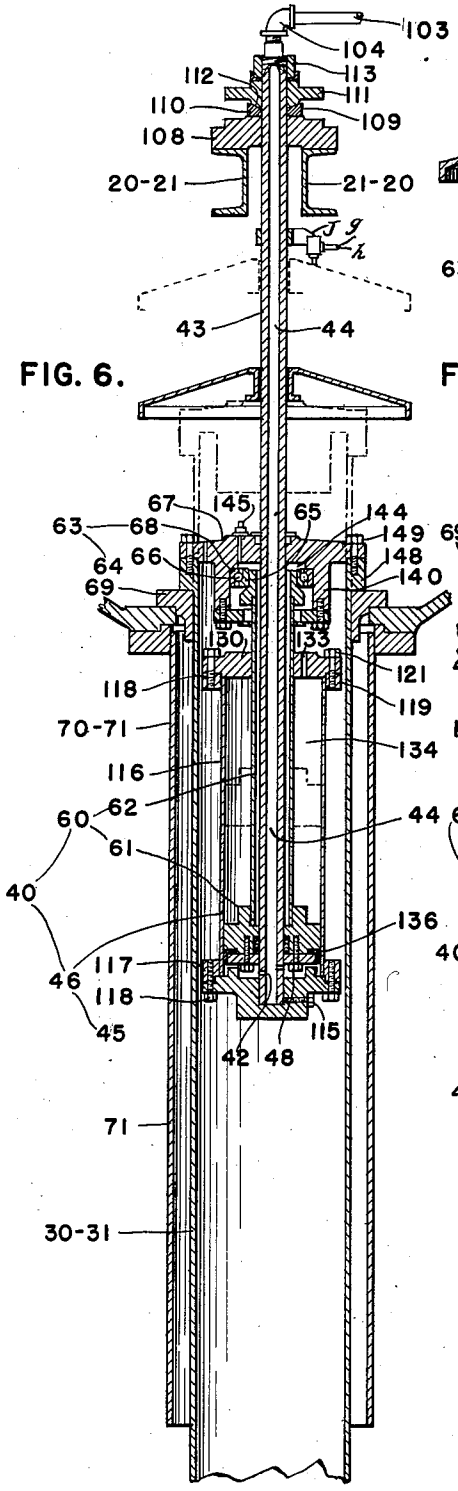



FIG. 6.

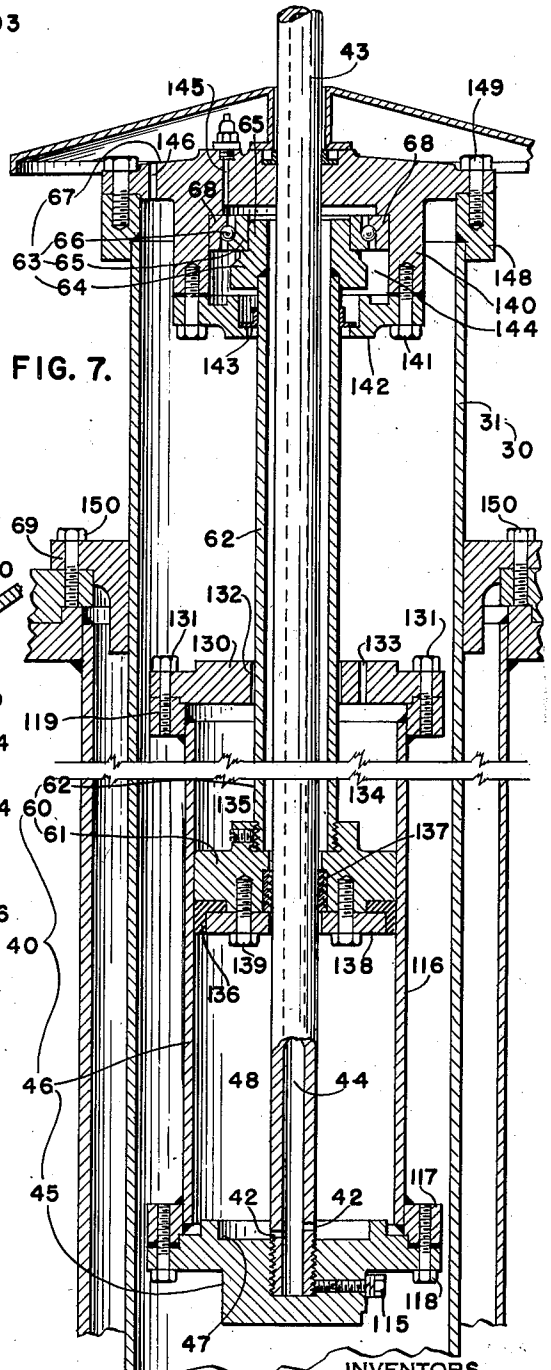



FIG. 7.

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# UNITED STATES PATENT OFFICE

2,585,006

## SEDIMENTATION UNIT

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Application January 29, 1947, Serial No. 725,086

12 Claims. (Cl. 210—55)

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This invention relates to sedimentation units, or thickeners as such units are sometimes termed, having motivated sedimented-collecting or sediment-impelling mechanism operable in a tank or basin over a floor or bottom section thereof, and the invention particularly relates to means adaptable for safeguarding the unit and the mechanism thereof against damage upon or consequent to abnormal overload conditions being encountered by or imposed on the sediment-engaging elements of said mechanism.

An object of the present invention is to provide novel apparatus or arrangement of parts or operative elements certain of which embody novel features of construction and operation whereby there is realized as a complete and effectively efficient organization a practical and reliable embodiment of operatively associated means that readily respond to the operative requirements for simple starting up of the apparatus, and also for continued normal operations, including an automatic raising of the sediment-engaging members according to substantial increases above maximum normal load conditions being encountered and a progressive lowering of the sediment-engaging members as the load condition reaches and decreases below the maximum normal therefor. The novel apparatus functions to arrest all operative movements of the sediment-engaging members or impelling elements and the driving mechanism therefor when an abnormal overload condition is substantially greater than that of the maximum normal has been encountered, such arresting of operation may be selectively determined and has in view the stopping or arresting of the movements of the sediment-impelling mechanism before damaging forces on the unit or parts thereof have been or are likely to be encountered.

Many novel features of construction are embodied in the sedimentation unit and particularly in connection with the power-actuated or motivated sediment-impelling mechanism and these novel features constitute or provide several different aspects or phases of the invention as will hereinafter more fully appear from the description which follows.

Certain novel features considered characteristic of the invention hereof 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 be understood from the following description of a specific embodiment when read

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or considered in connection with the accompanying drawings constituting a part of this specification and in which:

Fig. 1 is a vertical view—partly in section and with portions thereof broken away—of a typical tank or settling basis equipped with sediment-raking mechanism providing rake-carrying arms extending outwardly from a raisable lift shaft and in diverse positions of elevation therefor turnable about a vertically-extending axial line through the medium of suitable motivated mechanism.

Fig. 2 is a view taken as on the line 2—2 of Fig. 1 looking in the direction of the arrow. This figure shows certain details of construction whereby turning movement for a rake arm is imparted thereto from power-transmission member of the motivated mechanism.

Fig. 3 is a vertical view—partly in section—showing a main or primary motor with speed-reducing and power-actuated means constituting part of the motivated mechanism for turning the rake arms. This view also shows in assembly an auxiliary or pump motor and associated pump driven therein constituting part of an automatically-controlled hydraulic system embodying an expansible and contractible lifting means for effecting an automatic lifting of the rake-carrying arms as and when excessively heavy rake load conditions are encountered by the rake-carrying arms. In this figure there is indicated an electrical control system that automatically controls the starting and stopping of the pump and also for use in arresting the operation of the main motor should operating load thereof become sufficiently excessive whereby the motor or a part driven thereby might otherwise be damaged or caused to fail.

Fig. 4 is a vertical sectional view of a by-pass valve construction employed in the hydraulic system just referred to. The location of the valve of Fig. 4 is readily ascertainable from an inspection of either Fig. 3 or Fig. 5. The parts are shown in Fig. 4 at larger scale than in either Fig. 3 or Fig. 5.

Fig. 5 is a vertical view—partially in section and of which certain parts have been broken away—showing in cooperative arrangement certain details of the rake-carrying arms the hydraulic lifting means by which the rake-carrying arms are vertically positionable through the medium of the lift shaft from the lower end of which the rake-carrying arms extend and certain parts of the motivated mechanism by which said rake-carrying arms are caused to turn about a ver-

tically-extending axis for performing a sediment-collecting and impelling operation.

Figs. 6 and 7 are vertical sectional views illustratively showing the details of construction of the expansible and contractible lifting means which comprises a fixed cylinder and raisable piston employable for controlling the raising and lowering of the lift shaft, and the relative arrangement of said cylinder and piston with respect to a surrounding depending torque tube constituting part of the means by which power is transmitted to the rake-carrying arms for turning the same. In Fig. 6 the liftable or raisable piston is in low or contracted position therefor with respect to the cylinder. In Fig. 7 the piston and parts carried therefrom are shown in an upper position therefor.

Reference will now be made to the drawings in detail:

Therein a sedimentation tank or basin **10** as illustrated embodying a floor or bottom portion **11**, a marginal wall **12** rising from said bottom portion, a marginal launder **13** for receiving supernatant liquid overflow passing thereinto from the overflow weir or weir edge **14**; an effluent outflow **15** leading from the overflow launder **13**; a sludge- or sediment-receiving and discharge section provided by a sludge sump or cone at **16** served by a sump rake **26** and a discharge conduit **17** leading from the sump to a region outside of the unit.

Liquid to be treated for removal therefrom of settleable material is supplied to the upper central portion of the tank through the medium of a feed-supply means terminating in a feed-distributing well **18** having apertured feed-discharge openings at **19**.

Also associated with the tank and constituting a part of the sedimentation unit as a whole is a frame structure **20**, constituting a superjacent support, stationarily positioned with respect to the tank. This frame structure serves as a support for a portion of said supply means and feed-well thereof, it also serves as a support for a motivated sediment-raking mechanism collectively designated **25** and constituting the means by which settled solids on the tank bottom can be impelled towards and into a sediment-receiving sump provided in or by the bottom.

The sediment-raking mechanism collectively designated **25** embodies sub-sets of members or functioning mechanical elements which may be designated as follows:

1. Motivated power-transmission gearing **53** or main driving construction embodies a bull gear or wheel **52** constituting a main turntable which is turnable about a vertically-extending main axial line and which is mounted on a stationary bearing member **51** that derives carrying support from the I-beams **22** of the main frame structure **20**. Anti-friction balls or rollers may be provided as at **56** between the supporting and supported members **51** and **52** of a main turntable construction **50** thus provided thereby.

2. An expansible and contractible lifting means **40** embodying:

(*a*) A stationary lifting cylinder **46** of constant elevation having a low cylinder head **45** and cylinder wall rising therefrom, which cylinder **46** derives carrying support through the medium of a central depending carrying tube **43** concentric with said axis of which the upper end derives carrying support from the channel members **21** of the frame structure **20** while the lower end extends within the cylinder and has rigid



connection with the low head **45** of the lifting cylinder, and

(*b*) A liftable piston element **60** having an annular piston head **61** slidably fitting the interior of the cylinder wall and the exterior of the depending tube and a hollow piston rod **62** rising from said annular piston head. At the upper end of this piston rod **62** there is carried a liftable base or supporting member **64** constituting part of an auxiliary turntable construction **63** of which the turnably supported member or auxiliary turntable is provided by an annular cap **67**. The liftable base **64** has a raceway or supporting bearing **65** and the turntable cap **67** is provided with a raceway or supported bearing **68**; anti-friction rollers or balls **66** are provided between said raceways. The expansible and contractible lifting means **40** as provided by the lifting cylinder **46** and liftable piston element **60** may be viewed as a plunger means having a supported member **46** and a liftable plunger **60** and a pressure liquid receiving space **48** within the plunger means between the supported member **46** and the plunger **60** just referred to.

3. A liftable vertically-positionable sediment-raking element **30** embodying a vertically-extending liftable arm-carrying shaft or lift tube **31** equipped with intermediate arm-carrying members collectively designated **32** extending from the lower portion of the lift tube, and a set of outwardly-extending rake-carrying arms **33** carried from said intermediate members **32**. The lift tube or shaft **31** derives its liftable support from the auxiliary turntable **63** above referred to; and

4. Power-transmission mechanism collectively designated **70** and functioning between the bull wheel or main turntable **52** on the one hand and the rake-carrying arms **33** on the other hand. The power transmission mechanism **70** may be referred to as the bull wheel driven or motivated rake-arm turning mechanism. This mechanism embodies the torque tube **71** which is driven by and has depending carrying support from the bull wheel, an outwardly-extending frame structure generally designated **120** secured to and extending from the lower end **72** of the torque tube and hinged outwardly-extending power-transmission arms **80** of which the inner ends have hinged connections at **73** to the outlying members of said outwardly-extending frame structure **120** while the outer or swinging ends of the power-transmission arms have suitable connections as by links **90** to the corresponding portions of the underlying rake arms **33**.

The frame structure **20** also serves as a support for a liquid-supply means provided as by an oil or liquid-supply tank **100**, an associated pump **101** and an auxiliary motor PM which when the operating circuit therefor is closed actuates the pump. The pump is embodied in a hydraulic system and is connected through the medium of suitable piping so as to supply when actuated pumped oil or other liquid from said supply tank **100** to and through a central flow passageway **44** of the depending central tube **43** and so as to deliver the same under pressure through flow passageways **42** at the lower end of tube **43** into the stationary cylinder of the expansible and contractible means **40**, to wit, in the region **48** above the cylinder head **45** but below the piston head **61**, whereby the pressure liquid thus supplied can effect a lifting of the piston as a movable element of the expansible and contractible lifting means and thereby the auxiliary turntable construction

and the rake-carrying arms 33 which are indirectly carried from the auxiliary turntable construction through the medium of the liftable arm-carrying shaft 31.

It will also hereinafter more fully appear that the hydraulic system as constructed is provided with an outflow release line controlled by an adjustable valve for releasing bleeder liquid from within the expansible and contractible means for permitting a progressive lowering of the lift tube 30 and the rake-carrying arms after the motor operating the pump has ceased to run.

The depending torque tube 71 has an interior diameter substantially larger than that of the diameter of the exterior portion of the depending arm-carrying shaft 31. A flanged annular guide sleeve 69 at elevation higher than that of the overflow weir edge 14 is provided between the upper interior portion of the torque tube 71 and the exterior of the arm-carrying or lift shaft 31. This guide is preferably of bronze and serves not only as a guiding member but also as means for establishing and maintaining concentricity as between the upper end of the torque tube and that portion of the lift shaft at that particular elevation.

By the power-transmission mechanism 70 just referred to there is realized means whereby a continued turning of the bull wheel or gear 52 effects a horizontal turning of the rake arms 33 as a set about a vertically-extending axis for each and all diverse positions of elevation thereof.

Reverting to the motivating power-transmission gearing 53, it will be noted from an inspection of Fig. 3 that a motor M may be provided with a housing physically connected to and carried from a section of the casing structure for the motivated gearing 53. Power from the rotor of the motor is transmitted to an initially driven gear of the motivated mechanism 53, as for example, through the medium of pulleys and belts 59 the latter of which are indicated by dot-and-dash lines. The thus motivated power-transmission gearing 53 has gears or gear elements as 54 drivingly engaging a peripheral gear 55 of the bull gear or wheel 52 as is indicated in said Fig. 3.

Certain important aspects and features of the invention include a novel embodiment of a plunger lifting means in a sediment-raking mechanism; and furthermore in the coordinated operative arrangement and relationship thereof with respect to other functioning parts or means of the apparatus or equipment provided in or for a settling tank or basin or for use therein. That is to say, certain important aspects of the invention hereof revolve about (1) the construction and arrangement of parts constituting the expansible and contractible lifting means 40 that includes a lifting cylinder 46 having a low cylinder head 45 with cylindrical wall rising therefrom a vertically-movable piston 60 embodying an annular head 61 with piston rod 62 rising therefrom and having slidable fitting engagement with the interior of the cylindrical wall on the one hand and the exterior of a depending center support or cylinder carrying tube 43 on the other hand; (2) the mode of support for the stationarily mounted lifting cylinder from an overlying portion of the frame structure through the medium of the aforementioned tube 43 the lower end of which is fixedly connected to the cylinder head 45 whereby there is provided or left within the lifting cylinder an annular piston-receiving space rising from the cylinder head 45 and within



which space the piston head 61 has vertical rising and lowering movement; (3) to certain details of construction of the tubular support 43 and the associated cylinder head and piston head whereby fluid under pressure is deliverable into the tubular support and therefrom through passageway or flow openings 42 into the region 48 between the heads for imparting lifting movement to the piston and whereby a lowering of the piston can follow because of means provided in the hydraulic systems for allowing for a backflow and controlled release of bleeder liquid from the space 48 between the heads through openings 42 into the central-flow passageway 44 of the tube and from the upper end of the latter when conditions are right for lowering the piston; (4) the providing of a turntable construction 63 between the upper end of the hollow piston rod and the supporting cap or auxiliary turntable 67 from or by which there is turnably carried the lift tube 31 of the liftable raking assembly 30 whereby as the piston 60 is elevated it can impart a lifting movement to the lift tube 31 while at the same time permitting turning movement of the lift tube about the expansible and contractible lifting means 40 as a whole; (5) the arranging or positioning of the depending torque tube 71 and of the bull wheel 52 at elevations such that the bull gear and the upper end of the depending torque tube 71 which is connected thereto so as to be turnably driven thereby are located at elevations whereat they surround the upper portion of the lift tube 31, or as otherwise expressed, in a region surrounding but spaced from the vertically raisable and lowerable piston 60; and (6) the providing of a guide sleeve 69 between the bull wheel 53 and the connected upper end of the torque tube 71 on the one hand and the upper end of the lift tube 31 on the other, which said guide sleeve serves not only as a guiding member but also as means for insuring concentricity of the members just mentioned and also as a stop member carried by the bull wheel and functioning as a means for arresting and limiting the downward movement of the lift tube 31 and thusly of the rake-carrying arms 33 extending outwardly as a set from the lower end portion of the lift tube.

Many of the important features of the construction just mentioned are apparent from an inspection of Figs. 6 and 7 hereof and thusly it is in order to described certain parts thereof in further detail.

By Figs. 6 and 7 there will be seen certain details of construction of the specific means by which the center support or depending carrying tube 43 may derive or have carrying support from the channel members 21 of the frame supporting structure 20. The means thus shown embodies a supporting block 108 resting directly upon the channel members 21. Upon this support block 108 there is mounted a support block seat 109 having a concaved upper seat surface 110 following the general contour of a sphere. A center tube yoke 111 having a lower portion extending therefrom provides a convex surface 112 that directly and fittingly engages the concave face or seating surface 110 of the support block seat 109. The spherical seat construction just mentioned is provided whereby a desired adjustment of the vertical tube 43 can be readily realized, to wit, so as to attain substantial alignment with the vertical axis through the central portion thereof. A support tube nut 113 threadingly engages the upper screw-threaded portion of the tube 43 and serves as a member by which

the weight of the center support tube 43 and parts carried therefrom, is transmitted to the center tube yoke 111 and to the channel members 21. The upper end of the center support tube 43— which it will be noted is not turnable about an axial line—has secured thereto a pipe connection 104 constituting a part of the tubular piping or hydraulic means by which pressure fluid may be supplied to and into the depending support tube 43 and whereby the pressure or bleeder liquid may be released as bleeder liquid at the time when the piston 60 is being lowered or is permitted to have downward movement. The lower end of the tube 43 has a screw connection to the cylinder head 45 and is secured in place with respect to the cylinder head through the medium of a set screw 115. The lifting cylinder 46 which is herein described as having a cylindrical wall rising from the head 45 thereof has, as made, a tubular wall portion 116 the lower end of which has an annular flange 117 that is weld connected thereto which is directly connected to a corresponding flange portion of the cylinder head through the medium of bolts 118 and whereby a water-tight joint is provided between the lower end of the cylinder wall and the cylinder head. An upper flange member 119 is weld connected to the upper end of the cylindrical end or wall 116 and a piston rod guide 130 is connected by bolts 131 to the flange 119. This piston rod guide has an opening 132 provided therethrough for receiving the piston rod 62 heretofore referred to. An air passageway is provided at 133 whereby to permit an ingress or egress of air from the annular or piston slide space 134 that is provided or left between the interior of the cylinder portion 116 and the exterior of the hollow piston rod 62. The piston rod 62 which has been described as rising from the piston head 61 has a screw-threaded connection to the piston head 61 and is locked into position through the medium of a set screw or the equivalent at 135. The piston rod has annular cup-leather packings at 136 and a series of annular packings of inverted V-shape in cross-section arranged in superposed relationship at 137. These packings referred to are held in place by an annular retaining ring 138 which is secured in place at the lower face of the piston head 61 through the medium of bolts at 139. As to the turnable construction 63 which is carried at the upper end of the piston rod 62, this is shown in considerably greater detail than in the other figures hereof.

In Figs. 6 and 7 it will be observed that the supporting member 64 heretofore referred to and described as being carried at the upper end of the hollow piston rod 62 embodies a raceway bearing element 65 upon which the anti-friction balls or rollers 66 are directly supported. The lift tube cap 67 heretofore referred to as an annular cap or auxiliary turntable is provided with a turnably supported raceway member 68. The cap or turntable 67 has a depending annular flange portion 140 to which there is secured through the medium of bolts 141 a thrust end or underlying cap 142 equipped with an annular oil-sealing means 143 for retaining a quantity of lubricating liquid or oil in the region 144 whereat the ball bearing members 65, 66 and 68 are located. Means for introducing oil into the region 144 is provided at 145. A vent hole is provided at 146 in the cap or auxiliary turntable member 67.

The upper end of the lift tube 31 is provided with a flange ring 148 which is weld connected thereto and which is detachably connected through the medium of bolts 149 to the outer portion of the lifting tube cap 67.

Referring now to the guide sleeve 69 heretofore mentioned, it will be noted that this is secured in place through the medium of bolts 150 to the inner portion of the bull wheel or gear 52 and that it has sliding engagement with the exterior of the upper portion of the lift tube 31 whereby concentricity of arrangement as between the bull wheel 52 and the torque tube 71 connected thereto and carried therefrom on the one hand and the lift tube 31 on the other hand will be maintained and whereby indirectly the piston and cylinder of the lifting means 40 and the depending tubular support 43 by which the lifting means is carried will also be maintained in concentric relationship. It will also be noted that guide sleeve 69 also serves as a low-limit stop means for the lift tube 31 and parts carried thereby.

From that which has preceded, it will be manifest that the lifting means, the lift shaft which is raisable and lowerable thereby, and the actuating means by which from the torque tube the rake arms and parts carrying the same are caused to turn, are embodied in a novel construction realizable because of the novel arrangement of parts and members hertofore referred to.

The hydraulic means by which the expansible and contractible lifting means are caused to function is one which is preferably, but not necessarily under automatic control. No matter how controlled, viz. manually or automatically, it is important in realizing certain features of the invention to have a proper means for supplying liquid under pressure to the expansible and contractible means for imparting lifting movement to the rakes when overload conditions—surpassing those normally encountered—are experienced and for permitting the lowering of the rakes or rake-carrying mechanism after these overload conditions have been overcome. The hydraulic means heretofore mentioned and by which this is attained is shown in relatively complete detail in Figs. 3 and 5, however, an amplification of an important functioning part or relief valve thereof is shown at a larger scale in Fig. 4.

As previously mentioned, an oil supply tank or liquid-holding means is indicated as 100. In Fig. 5 the lower interior portion thereof is shown divided into three sections, to wit, 168, 169 and 170 by two partial partition members rising partway upwardly from the floor of the tank. This oil supply means has a pump motor PM physically connected for driving the pump 101 when the circuit for the motor is closed whereby to suck oil from the section 169 through a filter or strainer 171 into an intake or suction line 102 leading into the pump 101. From the pump 101 the pump discharges pressure liquid into a pressure delivery line generally designated 103 and leading to and terminating in the pipe connection 104 that in turn is connected to and in communication with the upper end of the depending tubular carrier 43. In this line 103 there is embodied a by-pass or relief valve 172, a back-flow check valve 173 and a pressure cage 174. The relief valve 172 is shown in section in Fig. 4 and is of a type well known in the art. This relief valve is constructed so that under ordinary or normally encountered operating pressures for the pump the flow from the pump is through a pipe section 175 of the pressure delivery line 103 directly past a depending portion 176 of a piston valve 177 into a pipe

section 178 leading to a check valve 173, the latter of which functions to allow a free forward flow of liquid entering the same on its way through pipe line 103 to pipe connections 104. The check valve 173 as embodied in the line 103 is provided to prevent any back-flow, to wit, into the relief valve 172. This relief valve 172, however, is so constructed that if the pressure in the line 103 which includes the sections 175 and 178 becomes unduly excessive there is a lifting of the piston valve 177 and consequent unseating of the depending valve section 176 from the seat or seat member 179 whereby there is permitted a by-pass, shunt or split off flow of liquid from the line section 175 past the unseated depending portion 176 of the piston valve into and through the seat 179 into pipe section 180 the latter of which delivers any thus by-passed liquid into the tank section 170. In this way there may be diverted all of the pumped liquid or only a portion of the pumped liquid from the line 175 into the tank section 170 thereby avoiding an undue supply of pressure liquid into and through the pipe 103 and correspondingly allowing the pump to be continuously operated well within the safe limits while the motor continues to run, or, as otherwise expressed, in a manner whereby to avoid undue overloading of the motor. Should the motor be stopped either by automatic control or otherwise the check valve at 173 prevents back-flow of pressure liquid from within that section of the line 103 which is physically located between the check valve 173 on the one hand and the pipe coupling 104 on the other. A pressure gauge 174 is provided whereby an operator can ascertain and have visual information as to the exact pressure conditions within the line 103 and thusly within the expansible and contractible lifting means 40.

Mention has heretofore been made of the fact that when the motor is stopped and thereby the pumping operation has been discontinued, as, for example, when raking overload conditions have been overcome that there can follow or should follow a progressive lowering of the lift tube 31 and of the rakes carried thereby. This progressive lowering is attained by the release of what may be viewed as bleeder liquid, to wit, liquid which flows upwardly within and from the tube 43, to wit, from the space 48 between the piston head 61 and the cylinder head 45 any liquid released as bleeder liquid flows into and from the pipe fitting 104 and in sequence through the pipe section 105, which may be viewed as a return pipe section, into and through the bleeder valve 106, and finally from the terminal section 107 of that which may be considered as a return or bleeder pipe leading into the tank-receiving portion 168. In this connection it will be noted that the position of the valve element 106, to wit, the bleeder valve as it should be called, can be adjusted for regulating the rate of back-flow of bleeder liquid from the progressively contracted space between the piston and cylinder heads towards and past the valve 106 and whereby the released liquid is ultimately received back into the liquid-holding tank. The weight of the lift tube 31 and the parts carried thereby are sufficient to effect the lowering of the parts carried by the piston and the back-flow of the released or bleeder liquid until the raking elements have assumed the normal low-raking position therefor.

At this juncture it will be noted that a stop member 47 rising from the low-cylinder head 45 arrests the downward movement or determines the low-limit movement of the piston relative to the head 45 and assures a liquid-receiving space 48 into which presure liquid can at all times be delivered from the interior of the tube 43 through the flow opening 42 at the low end thereof.

Mention has heretofore been made that there is progressively employed an electrical control system whereby when unduly excessive overload conditions are experienced by the motor this will automatically be stopped before the motor burns out and before there is experienced a rupturing of some part driven by the motor to the deteriment of the sedimentation unit as a whole. The control system also has means embodied therein and constituting a part thereof whereby upon excessive raking load conditions being encountered the pump motor will be started and thus operate the pump to progressively lift the raking mechanism until the excessive overload conditions have been overcome at which time there follows an automatic stopping of the motor whereby the progressive lowering of the raking mechanism can be accomplished through the medium of the hydraulic system thus described.

From what has preceded, it will be manifest that during the normal employment of the sedimentation unit for the purpose of effecting the clarifying of the liquid bearing settleable solids that the supply of such liquid to the tank or basin is of more or less uniform rate that the motor M is continuously operating progressively collecting sedimented material from diverse portions of the floor of the tank towards the sediment sump 16 that upon abnormally excessive raking overload conditions being encountered by the sediment-raking mechanism the motor is caused to actuate and thereby operating and supplying pumped liquid into the space between the lifting cylinder head and the liftable pump head of the piston thereby effecting a progressive lifting of the rake lifting means while the latter is continued to be turned by the motor M through the gearing and the medium of the bull wheel thereof the depending torque tube secured to and depending from the bull wheel and the power-transmission arms extending from the lower portion of the bull wheel and having a link connection to the rake arms underlying the same whereby there is permitted the requisite lifting movement to the rake arms while at the same time imparting horizontal turning movement thereto about a vertically-extending axis.

The motors M, PM are preferably but not necessarily embodied in an automatic system according to which operating energy-specifically electrical energy for operating motors is controllably supplied from a suitable source of electrical energy supply generally designated SE through a control system generally designated CS from which there is a control supply of power through one set of wiring to the motor M and through another set of wiring, which may be referred to as a branching energy-transmission means or line, leading to the motor PM that actuates the pump 101 according to operative requirements. The branching line just referred to includes the wires *f* and *e* (see Fig. 3) and an automatically positioned control switch such as switch member actuated by magnetic coil B. In other words, according to the control system

just referred to during the normal raking load operations the motor M is actuating the sediment-raking mechanism 25, to wit, in the general normal or low operating position for the rake-carrying arms 33 thereof. If, however, the raking load becomes abnormally excessive this control system CS comes into play, through the medium of the branching energy-transmission line, to start the operation of the motor PM for effecting of the delivery of pressure liquid, to wit, oil under pressure from the pump into the expansible and contractible lifting mechanism 40 for expanding the latter and thereby effecting an automatic lifting of the liftable element thereof and a consequent upward movement of the lift tube 31 from which the rake-carrying arms 33 extend. When the excessive rake load conditions have been overcome there is an automatic stopping of the motor PM and this is followed by a permissible lowering of the previously lifted rake-carrying arms 33 due to a progressive contracting of the expansible and contractible lifting means, which contracting is permitted to take place because of the progressive release of the oil or other liquid through and from the bleeder valve 106.

Also in the electrical control system CS provision is preferably made for automatic stopping of the motor M and thereby stopping of all turning movement of the raking mechanism should the load upon the latter become sufficiently excessive, to wit, to an extent whereby the motor M or other mechanism actuated therefrom might be otherwise damaged. Electric wiring from the control system CS to motor M is indicated as *c* and *d* while electric wiring from the control system CS to the pump motor PM is indicated as *f* and *e*.

In short, however, according to the control system just referred to during normal raking load operations the motor M functions through the medium of the belt-drive 59 and the motivated power-transmission gear 53 to effect a horizontal turning of the depending torque tube 71 and therefrom to the underlying rake-carrying arms 33 through the medium of the hinged outwardly-extending power-transmission arms 80 of which the outer ends have link connections 90 whereby said arms 33 as a set have horizontal turning movement about the main vertically-extending axial line and whereby they are thus operable in any position of elevation therefor as well as at any and all times when being changed from one elevation to another.

Also during the time when the rake load sufficiently exceeds a normal raking load but is not sufficiently excessive to damage the motor or parts actuated therefrom the motor M continues to operate and thus functions to effect the continued turning of the rake arms but under such abnormal overload conditions as those just stated, the control system CS is such as to cause the starting up operation of the pump motor PM and thusly the pump 101 whereby to send pressure liquid into the expansible and contractible lifting means 40 for effecting a raising of the rake-carrying arms 33 with a consequent lessening of the raking load. This upward movement of the raking arms continues until the abnormally excessive overload conditions have been overcome at which time the control mechanism causes the pump motor to automatically stop and a progressive lowering of the rake arms can follow. For supplying liquid under pressure that is relied upon for expanding the expansible and contractible lifting means as provided by the piston and cylinder construction referred to herein, reliance is made upon a hydraulic system that includes a pump 101 actuated from the motor PM which when operating delivers liquid, to wit, oil under pressure, into the upper end of the depending carrying tube 43 and which hydraulic system is equipped with a valve-controlled bleeder line that functions to permit a gradual release of entrapped liquid in the system whereby to permit a contracting of the expansible and contractible lifting means, or as otherwise expressed, a progressive lowering of the piston after the motor has ceased to actuate the pump. This hydraulic system will hereinafter be described in detail.

The main motor M and the pump motor PM just referred to are preferably, but not necessarily embodied in an automatic system according to which electrical energy for operating the motors is controllably supplied from a suitable source of electrical energy generally designated SE through a control system generally designated CS from which there is a control supply of power through one set of wiring to the motor PM that actuates the pump 101 according to operative requirements, etc.

As to the supply means 100 and pump 101, it will be noted that the member 100 may be a tank preferably holding oil from which by means of the pump 101 oil is pumped according to operative requirements from the lower interior portion of the tank or container 100 through the medium of a suction pipe line 102 and is delivered under pressure from the pump through the pressure line 103 into a pipe connection 104 thence into the upper end of the stationarily-supported depending tube 43 by which the lifting cylinder is carried and from which tube liquid under pressure is deliverable into said cylinder between the cylinder head 45 and into the region at the underside of the annular piston head 61 of the liftable piston element 60. A return or bleeder pipe line leads from the pipe connection 104 and embodies a pipe section 105, an adjustable bleeder valve 106 and a terminal pipe section 107 that delivers the returning or bleeder liquid back into the supply tank 100. The bleeder line thus provided functions as means for controlling the outflow of the bleeder or release liquid from the region between the cylinder and piston heads just mentioned back into the tank particularly as and when the lifting load within the lifting means is no longer required, to wit, at a time when the parts of the expansible and contractible lifting means 40 are assuming the contracting position relative to each other. The pump 101 is actuated by and from a pump motor PM.

The electrical control system is diagrammatically imposed upon Fig. 3 and is now described in connection therewith.

Said electrical control system CS as a whole embodies the following features entering into its construction:

1. Disconnect or power line switch A;

2. Main motor M with its respective control consisting of magnetic starter coil C with its magnetically-controlled contacts C1, C2 and C3, thermal overload heater unit HH, a series overload relay G with its relay actuated contact G1, a manually-actuated momentary-contact "Start" push button E and a manually-actuated momentary-contact "Stop" push button F;

3. Pump motor PM with its respective control consisting of magnetic starter coil B with its magnetically-controlled contacts B1 and B2. Also a

manually-actuated momentary-contact "Raise" push button D for manual operation of motor PM;

4. Extreme upward-lift limit switch J and thermal overload heater unit switch HS for the control of both main motor M and pump motor PM.

The electrical control embodying the foregoing features operates as follows:

I. The disconnect or power line switch A is manually closed to connect the source of energy SE to the control system CS and motors M and PM. When the normally-open momentary-constant "Start" push button E is pressed, then coil C of the magnetic starter for the main motor M is energized, thus closing its normally-open magnetically-controlled contacts C1, C2 and C3. The closing of the latter contact C3, which short-circuits or bridges the normally-open momentary-contact "Start" push button E, maintains the energization of coil C, thereby holding closed its normally-open contacts C1, C2 and C3, namely, after the normally-open momentary-contact "Start" push button E is released.

II. Current then flows from the source of energy through the disconnect or power line switch A, wire *a*, contact C1, thermal overload heater unit HH, wire *c* and through main motor M. Then back to the source of energy through wire *d*, series overload relay G, contact C2, wire *b*, and through disconnect power line switch A to the source of energy. Main motor M, now running causes the rotation of the rake arms.

III. An overload on main motor M would cause an increased flow of current through the aforementioned path. This increased flow of current through series overload relay G would cause it to be actuated, therefore closing its normally-open movable-member contact G1, which short circuits or bridges the normally-open momentary-contact "Raise" push button D. This causes coil B of pump motor PM magnetic starter to become energized, thus closing its normally-open contacts B1 and B2.

IV. Current then flows from the source of energy through power line switch A, wire *a*, contact B1, wire *e*, and through pump motor PM. Then back to the source of energy through wire *f*, contact B2, wire *b*, and through power line switch A to the source of energy. Pump motor PM now running, causes the rakes to be raised (by means of the hydraulic lift mechanism) progressively relieving the overload or main motor M. This reduces the current flow through main motor M ultimately allowing series overload relay G to reset, thus opening its contact G1. This results in opening the circuit of coil B in the magnetic starter of pump motor PM, thus allowing said coil B to become de-energized and open its movable contacts B1 and B2, thusly disconnecting the pump motor PM from the source of energy thereby allowing it to stop.

V. If, however, the aforementioned overload on main motor M continued to exist in spite of the lifting action on the rakes, the pump motor PM would continue to operate, because of the continued increased current flow through the main motor M and its respective control circuit. This continued operation of the pump motor PM would cause the rakes to be lifted until said rakes reached an extreme position, whereupon a member of the lifted portion of the machine would operate the extreme upward-lift limit switch J and open its normally-closed contact, thereby disconnecting the source of power from the control circuits of both the main motor M and the pump motor PM, causing both the main motor M and the pump motor PM to stop. In this case the original starting sequence described in paragraph "I" hereof must be followed in order to restart main motor M.

VI. In the event the main motor M was overloaded to the extent where it was unable to drive the rake mechanisms because of some binding action on said rakes, or in the event main motor M is stalled because of some abnormal overload, the thermal overload heater unit HH which is in the main motor M current supply line, would become abnormally heated causing its normally-closed thermal overload heater unit switch contact HS to open. The thermal overload heater unit switch HS, being in both, the control system of the main motor M and the control system of pump motor PM, would disconnect the control systems of both the main motor M and the pump motor PM from the source of energy and therefore effect a stopping of both of said motors before damage could be done to either the motors or any mechanical member of the machine.

VII. The pump motor PM, which is the driving means for the pump 101 of the hydraulic lifting means, which in turn causes the lifting action on the rake arms, may be operated at will regardless of the existing load conditions by pressing to close the normally-open momentary-contact "Raise" push button D. This action is, in effect, the same as that produced by the aforesaid movable contact member G1 of series overload relay G, only that this action is controlled manually.

VIII. The main motor M and the pump motor PM may be stopped, according to the discretion of the operator, at any time regardless of the condition of load, or the position of the rakes, etc. by pressing to open the normally-closed momentary-contacts of "Stop" push button station F.

We claim:

1. A mechanism of the class described for use in a liquid-retaining basin having a superjacent frame structure and comprising sediment-raking blades; a liftable turnable carrier for the blades; plunger means supported from the frame for raising and lowering the blade carrier; a driven turnable bull-wheel mounted from the frame; means effective between the bull-wheel and the blade carrier for turning the carrier in various operative elevations thereof; and a primary motor for turning the bull-wheel; characterized by an oil reservoir, a pump having a suction line leading from the reservoir and a discharge pipe for delivering pressure oil to the plunger when the pump is actuated, a return pipe for oil from the plunger to the reservoir, an auxiliary motor for actuating the pump, and an energizable primary control for operating the primary motor to turn the blade-carrier and having an automatically shiftable load-responsive control member normally in non-transmitting condition except when displaced into an abnormal energy transmitting condition during abnormally heavy load conditions encountered by the blades, and a secondary control energizable from the primary control extending to the auxiliary pump motor and adapted to be disrupted from energy-transmitting condition when the shiftable control is in its normal non-transmitting condition but to be re-established in transmitting condition during the encountering of abnormally heavy load conditions by the blades.

2. Mechanism according to claim 1, wherein

there is a check valve in the discharge pipe for preventing back-flow into the pump.

3. Mechanism according to claim 1, in which the intake section of the discharge pipe has a check valve for permitting free forward flow from the pump into the plunger means but for preventing back-flow into the pump, and a pressure-gauge connected into said discharge pipe at a locality between the check valve and the plunger means.

4. Mechanism according to claim 1, in which there is an adjustable needle valve disposed in the return pipe for permitting contraction of the plunger means when overload conditions have been overcome.

5. A sediment-raking mechanism comprising a main driving construction having an annular supporting bearing of constant elevation and an open center bull-wheel mounted thereupon for turning movement about a vertically-extending axis; a vertically-extending lift shaft concentric with the bull-wheel; rake arms extending from the shaft; a torque tube driven from the bull-wheel and surrounding a portion of the lift shaft; and means by which turning movement is imparted from the torque tube to the rake arms, said mechanism being characterized in that it includes a fixed vertically-extending support tube concentric with said axis adapted for alternately receiving pressure liquid within and for releasing liquid from the upper portion thereof by having constantly open liquid flow passage area between the lower interior portion thereof and a confining liquid-receiving space between the cylinder and piston hereinafter referred to; a cylinder having a head secured to the lower end portion of the tube and cylinder wall rising from the head, a piston in the cylinder having an annular piston-head encircling the tube and a hollow piston-rod rising from the piston-head to an elevation higher than that of the upper end of the cylinder walls, and an auxiliary turntable carried from the upper end of the piston-head providing carrying support for the lift shaft.

6. Sediment-raking mechanism according to claim 5 having valve bleeder means leading from the support tube for releasing liquid and thereby lowering the piston after the lifting means has been expanded.

7. Sediment-raking mechanism according to claim 5 in which the lift shaft has a cap having slidable, guidable engagement with and along the support tube.

8. Sediment-raking mechanism according to claim 5 in which there is provided an annular guide sleeve between the bull-wheel and the exterior of the lift shaft.

9. A sediment-raking mechanism comprising a main driving construction having an annular supporting bearing of constant elevation and an open center bull-wheel mounted thereupon for turning movement about a vertically-extending axis; a vertically-extending lift shaft concentric with the bull-wheel; a torque tube driven from the bull-wheel and surrounding a portion of the lift shaft; and means by which turning movement is imparted from the torque tube to the rake arms characterized in that it includes plunger means having a supported member and a liftable plunger member providing between them a pressure liquid-receiving space, a fixed vertically-extending support tube concentric with said axis adapted for alternately receiving pressure liquid within and for releasing liquid from the upper portion thereof by having constantly open liquid-flow area passageways at a lower end portion leading between the interior portion of the support tube and the pressure-receiving space, and an auxiliary turntable carried from the upper end of the plunger and providing carrying support for the lift shaft.

10. Apparatus according to claim 9, in which there is an annular member providing a guide sleeve between the associated bull wheel and depending torque tube on the one hand and the exterior of the lift shaft on the other.

11. Apparatus according to claim 9, in which an annular guide sleeve is provided between the bull wheel on the one hand and the vertically-liftable auxiliary turntable and lift shaft carried therefrom on the other hand which auxiliary turntable and lift shaft collectively constitute a vertically-movable unit and include means overlying the annular guide sleeve thus functioning as a stop that engages said guide sleeve and thereby determines the lowermost position of the lift shaft.

12. An apparatus according to claim 9, in which there is a liquid-holding tank, an associated pump having an intake section leading from the interior of the tank into the pump, a discharge section leading from the pump for delivering pressure liquid into the support tube, and a bleeder line leading from the interior of the support tube into the tank and embodying an adjustable valve whereby to control the back-flow of bleeder liquid into the tank and thereby providing for a progressive lowering of the plunger following a period in which the pump has been actuated.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| 1,702,192 | Bloomfield et al. | Feb. 12, 1929 |
| 1,702,193 | Bloomfield et al. | Feb. 12, 1929 |
| 1,995,559 | Andrews | Mar. 26, 1935 |
| 2,140,059 | Simonsen | Dec. 13, 1938 |
| 2,291,836 | Scott | Aug. 4, 1942 |
| 2,295,943 | Finney | Sept. 15, 1942 |
| 2,360,817 | Scott | Oct. 17, 1944 |
| 2,467,409 | Smith | Apr. 19, 1949 |