Oct. 7, 1958 C. H. SCOTT 2,855,101

OVERLOAD RESPONSIVE ALARM FOR DRIVE MOTOR

Filed Feb. 5, 1957 4 Sheets-Sheet 1

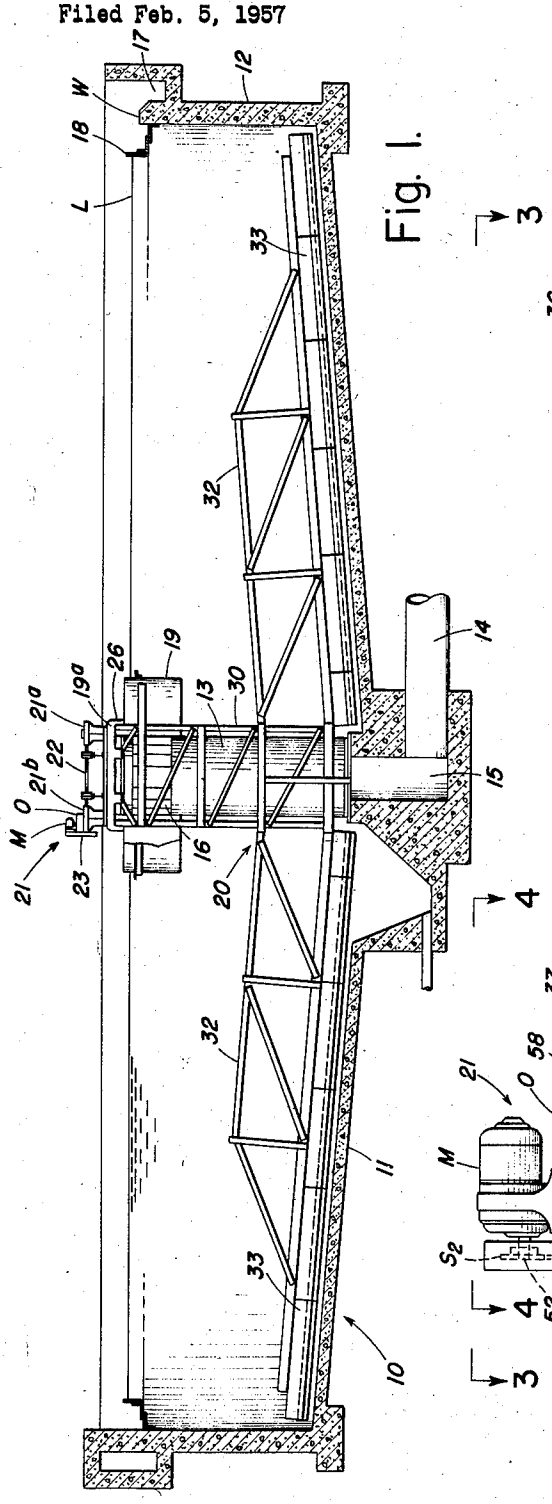


Fig. 1.

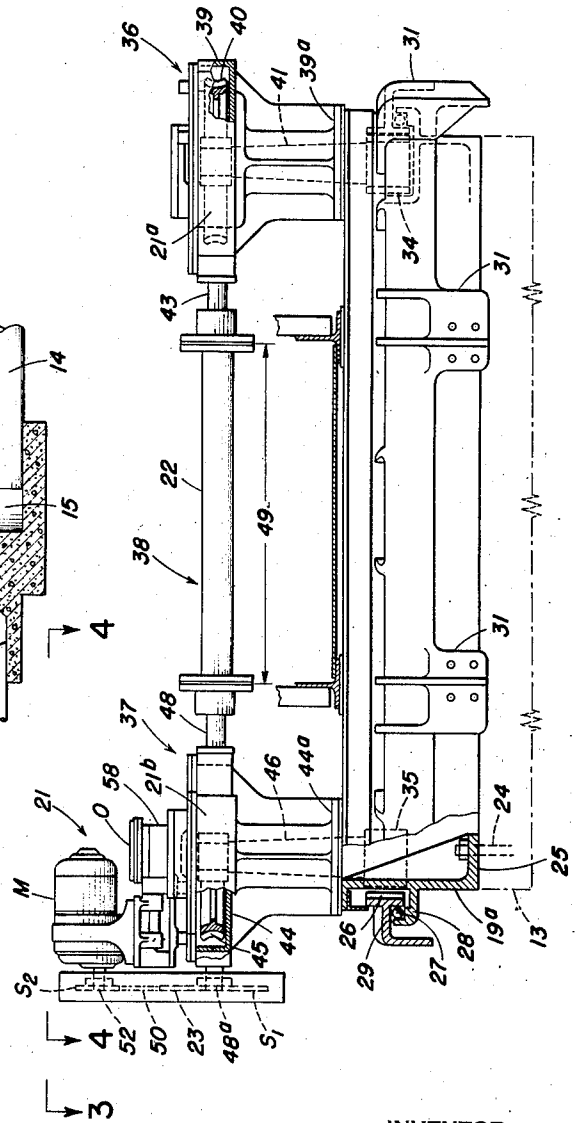


Fig. 2.

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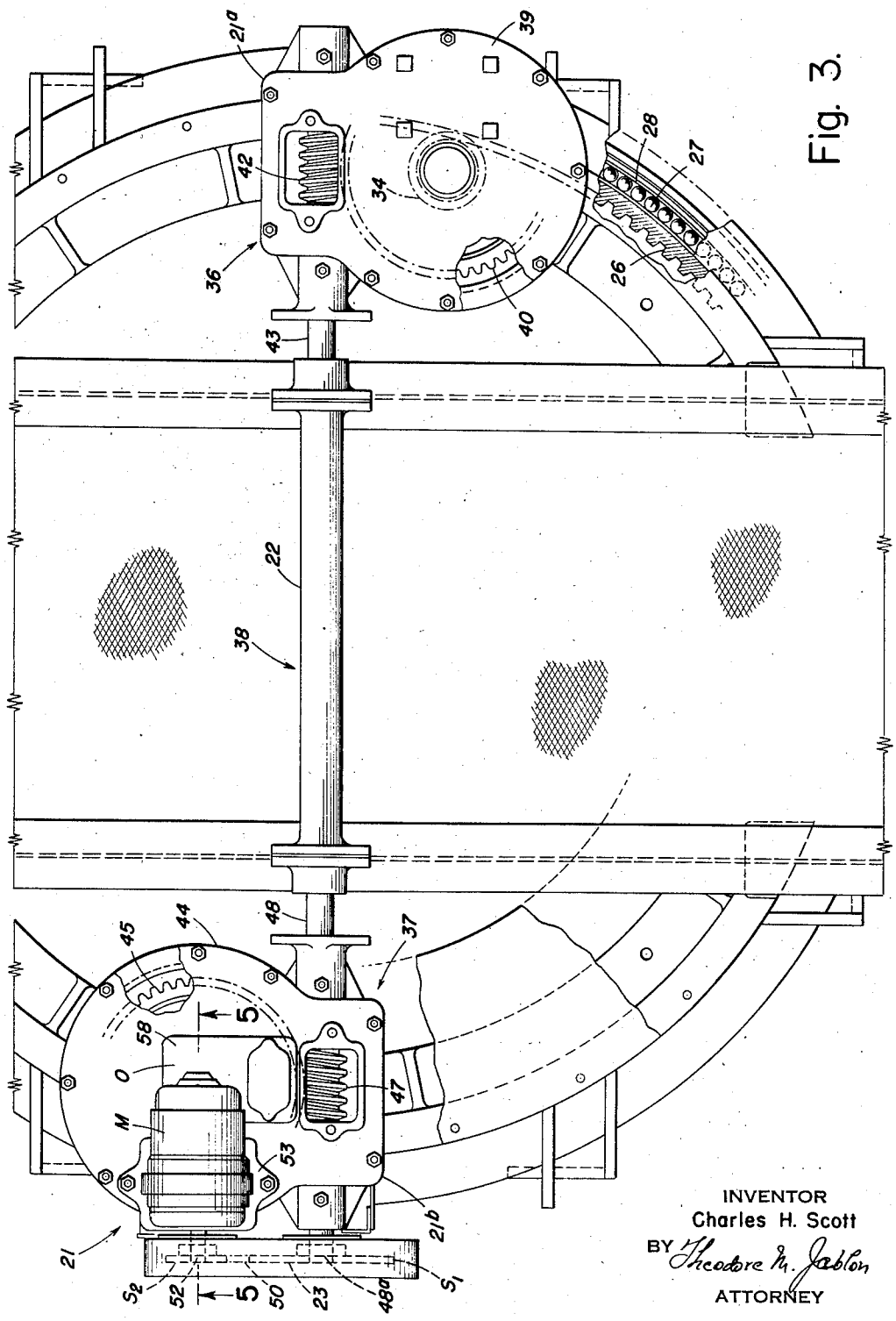


Fig. 3.

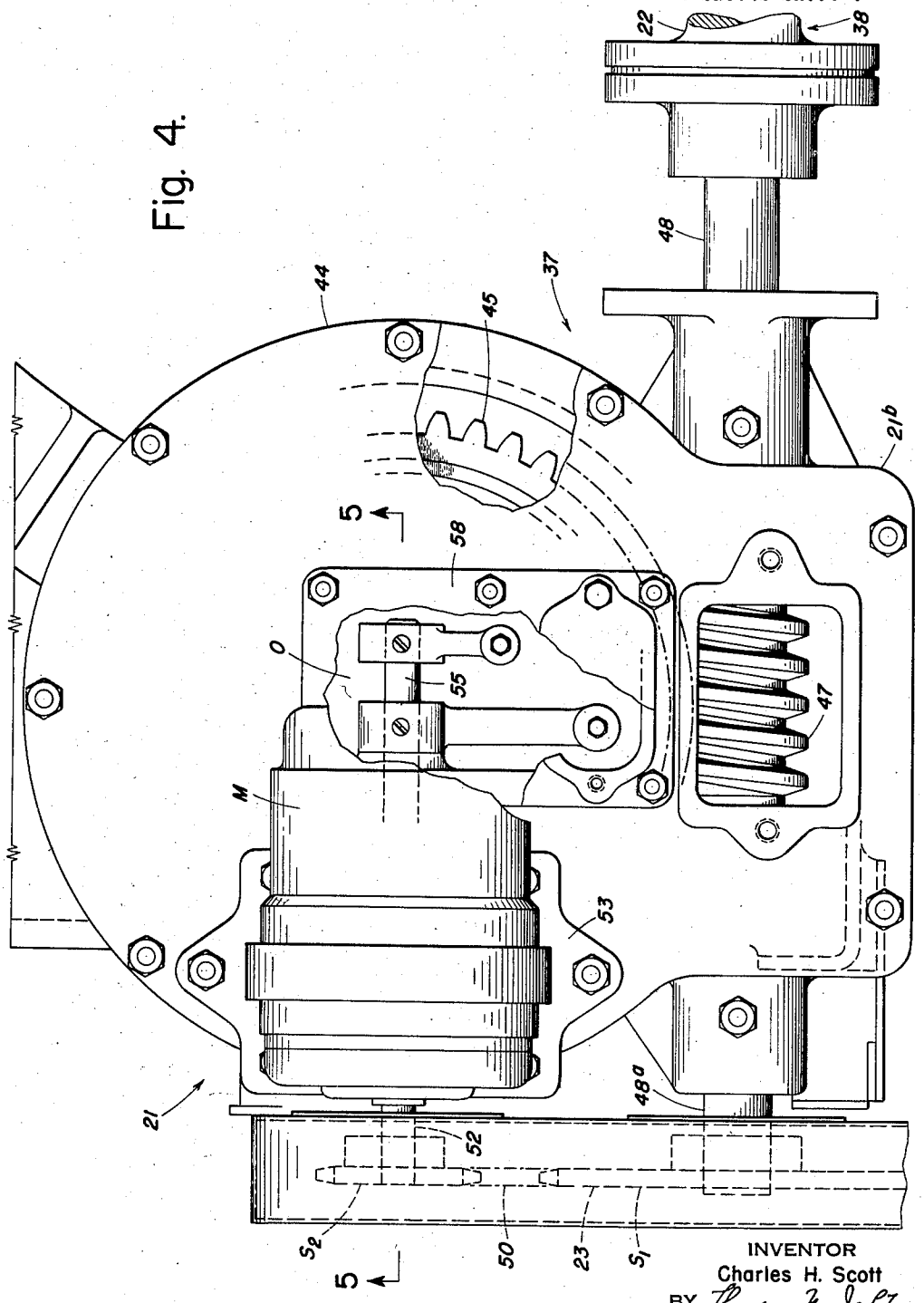
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OVERLOAD RESPONSIVE ALARM FOR DRIVE MOTOR

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Fig. 4.



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OVERLOAD RESPONSIVE ALARM FOR DRIVE MOTOR

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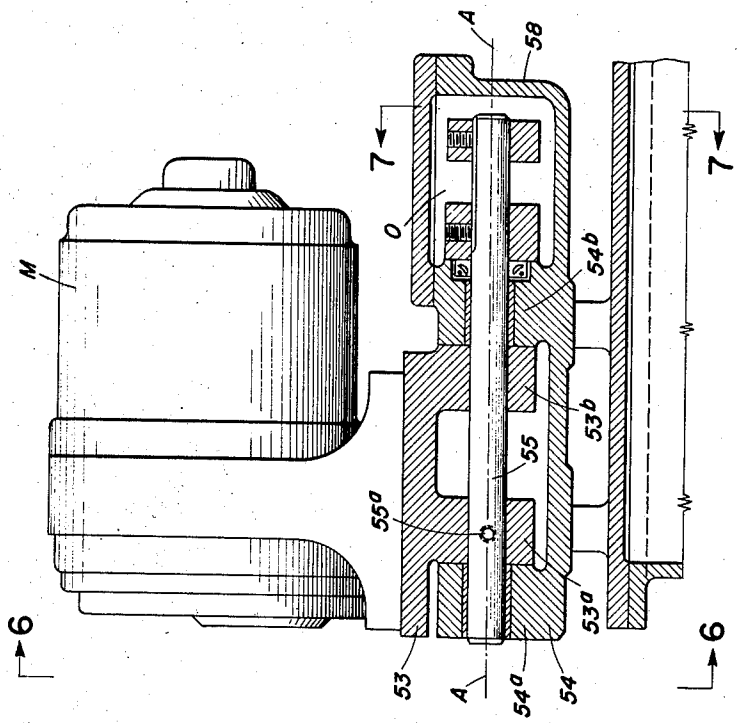


Fig. 5.

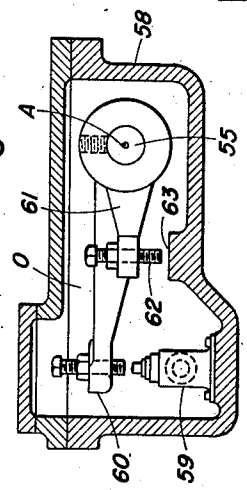


Fig. 7.

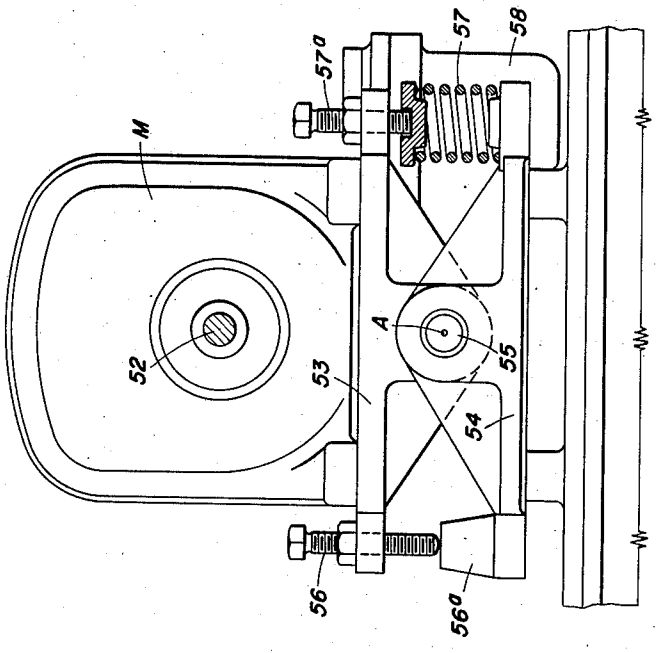


Fig. 6.

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United States Patent Office 2,855,101 Patented Oct. 7, 1958

2,855,101

OVERLOAD RESPONSIVE ALARM FOR DRIVE MOTOR

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Application February 5, 1957, Serial No. 638,247

1 Claim. (Cl. 210—85)

This invention relates to powered reduction gear drive mechanism with overload-responsive means adapted to actuate an alarm or else to effect stoppage of the drive motor.

Although in no limiting sense, this invention is herein shown embodied in a settling tank of the center pier type in which a solids carrying feed liquid upflowing through the hollow central pier is admitted centrally at the top of the tank while clarified liquid overflows at the periphery, and a rotary raking structure turnably supported by the pier conveys a sludge load of settled solids over the tank bottom toward the center of the tank for discharge.

Hence, in a more specific sense, this invention relates to an improved combination of a powered reduction gear drive mechanism for the rotary rake structure, with overload-responsive means.

The drive mechanism here considered is of the torque-balanced kind, in which a large bull gear is driven simultaneously at a plurality of points of its periphery, and in such a manner that interbalanced shares of the drive torque be imparted to respective drive pinions engaging the bull gear, with the result that power requirements as well as wear and tear upon the mechanism are minimized. Applying the driving torque to the periphery of the bull gear in a balanced manner is desirable and important because of the slow rate of rotation of the raking structure especially where large diameter sedimentation units are concerned, and in view of the high tooth pressures that would otherwise arise between a bull gear and a driving pinion.

The object of this invention is to provide simple drive mechanism capable of applying a true or balanced drive torque to the rake structure, jointly with providing overload-responsive means that are sensitively and positively adjustable in order that they may become effective substantially at the exact overload anticipated.

The significance of that objective will be appreciated in view of the fact that heretofore the conditions for providing accurate overload-responsive means were contrary to and not reconcilable with those conditions that would provide a balanced torque. It is axiomatic that in order to register overload accurately the overload-responsive mechanism must be designed for directly and mechanically utilizing the torque reaction of the drive mechanism itself, and such overload has been known to be registered and utilized through and from the actual thrust reaction of a drive worm constituting part of the drive mechanism. On the other hand, to provide balanced torque operating conditions in the mechanism requires neutralizing and in fact eliminating such axial thrust reaction. Therefore, as a compromise solution of the problem, the overload-responsive devices employed in conjunction with balanced torque drive mechanism were those responsive to an electric overload imposed upon the drive motor for that mechanism. They were thus electrical overload-responsive devices as distinct from those of a direct acting mechanical nature. Indirect electrical criteria are not positive and not very satisfactory, nor

are they reliably adjustable to respond correctly at predetermined overloads upon the rake structure, compared with the much more positive and accurate criteria of direct mechanical torque reaction forces.

This invention is applicable advantageously to the rake drive mechanism of large size sedimentation tanks of the center pier type, where heavy torque loads coincident with very slow rotation of the rake structure are involved. In that instance, the rake structure comprises a central cage portion surrounding the center pier, and rotatably supported thereon by an annular vertical thrust bearing atop the pier. Consequently, a self-contained drive mechanism is also mounted upon the top of the pier designed to engage and drive the large annular bull gear that is unitary with the rake structure, for rotating the same.

Torque-balanced drive mechanism for rotating such pier supported rake structure is known, for example, from the patent to Scott No. 2,086,394 which comprises a pair of drive pinions engaging the internally toothed bull gear at diametrically opposed points. These drive pinions are driven simultaneously through a pair of spur gear trains extending in opposite directions from a motor disposed centrally atop the pier. The motor torque is transmitted to the gear trains by way of compensatory torque balancing means effective to transmit equal shares of the drive torque of the motor to the respective drive pinions having drive engagement with the bull gear.

Hence it is a more specific object to provide torque-balanced drive mechanism of great simplicity and compactness employing high reduction ratio of worm drive means instead of trains of spur gears, for rotating the bull gear in order to effect a slow rotation of the rake structure, in combination with mechanically accurate non-electrical and direct-acting overload-responsive means applicable irrespective of the kind or type of drive mechanism employed.

According to this invention, these objects are attainable by providing a drive mechanism in which the torque input shaft is driven from the motor through an endless although positive acting torque transmitting element such as an endless chain running over a pair of sprockets, while the motor itself is fixed to an adaptor member which is movable upon a base. Thus the motor is movable or tiltable in a direction co-extensive with the plane defining the path of the endless chain, or else movable in a direction towards and away from the input shaft in a direction lying in a plane at right angles to this input shaft. When an overload occurs in the operation of the rake structure, the correspondingly increased pull exerted by the drive motor upon the taut portion of the endless drive chain will act to overcome adjustable spring pressure provided to bodily urge the motor away from the input shaft. This increased pull of the chain will move or tilt the motor with its adaptor member to actuate a switch producing an alarm signal or effecting the stoppage of the drive motor.

In a practical embodiment, with the invention applied to the center pier type sedimentation tank, there is provided at the top of the pier a frame or platform having peripheral bearing means for rotatably supporting the internally toothed bull gear that is patr of the rotary raking structure which surrounds the pier.

Equal shares of drive torque are imparted to the bull gear simultaneously by a pair of drive pinions engaging the bull gear at diametrically opposed points thereof. Each pinion is driven directly by a worm gear drive unit located above and mounted upon the outer marginal portion of the platform structure, each worm gear and the associated drive pinion being operatively interconnected by a vertical shaft. Both worm drive units in turn are operatively interconnected by means of a common horizontal drive shaft. This shaft represents the

torque input shaft of the drive mechanism, and extending diametrically of the bull gear, carrying at each end the respective worm element that is part of the respective worm gear unit. This torque input shaft is thus balanced with respect to the actual thrust exerted by the respective worms.

This particular arrangement of the components of the drive mechanism relative to one another as well as relative to the supporting frame, has the added advantage that the major portion of the frame or platform structure remains unencumbered, and especially the central portion thereof unobstructed so that the hollow interior of the pier is readily accessible through a central opening in the frame clear of all driving mechanism. In this connection, it is to be noted that the common torque input shaft is sectionalized so that the intermediate portion thereof can be disconnected from the end portions, for the purpose of clearing the entire area between the two worm drive units for access to and inspection of the interior of the hollow pier below.

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

Figure 1 is a vertical sectional view of a sedimentation tank of the center pier type diagrammatically indicating the type of drive head for rotating the rake structure, and representing the environment for the invention associated with the drive mechanism.

Figure 2 is a geratly enlarged side view of the drive mechanism taken from Figure 1, although with a portion broken away to show annular bearing means for supporting the rake structure.

Figure 3 is a further enlarged plan view of the drive mechanism taken on line 3—3 of Figure 2, with a small portion broken away for showing the annular bearing means for the rake structure.

Figure 4 is a still further enlarged plan view of the drive motor arrangement with overload-responsive devices, taken on line 4—4 of Figure 2.

Figure 5 is a vertical sectional view of the drive motor and associated overload-responsive device, the section being taken on line 5—5 of Figure 4.

Figure 6 is an end view of the detail motor mounting, taken on line 6—6 of Figure 5.

Figure 7 is a vertical sectional detailed view of the overload responsive device, taken on line 7—7 of Figure 5.

As an example of the environment of this invention there is shown in Figure 1 a large concrete sedimentation tank of the center pier type. A rotary rake structure is supported upon the center pier, which pier also carries self-contained thereon the powered drive mechanism or drive head to effect rotation of the rake structure. According to this embodiment, the invention resides in the combination of the drive mechanism with overload-responsive devices characterized more particularly by the fact that these devices are actuated directly by the torque reaction that manifests itself in bodily displacement of the drive motor of the mechanism resisted by the spring pressure which is adjustable.

Figure 1 comprises a bottom **11**, a cylindrical wall **12** and a hollow center pier **13**. The tank is fed as usual through a horizontal influent duct **14** leading into a vertical duct **15** upwardly through the center pier **13**. Hence, influent liquid passing outwardly through influent openings **16** at the top end of the pier enters the body of quiescent liquid that is being held in the tank for the purpose of solids sedimentation, and defined by its overflow level "L." A usual peripheral overflow weir W determines the level of the liquid overflowing into a surrounding effluent receiving launder **17**. A usual circular scum baffle **18** is also indicated, together with a usual cylindrical influent well **19** surrounding the top end portion of the pier as well as the influent feed openings **16** therein.

Atop the pier **13** there is mounted and anchored a frame or platform **19** in the form of a hollow annular casting to furnish operating support for a rotary rake structure **20** as well as for a drive mechanism indicated at **21** and which mainly comprises a pair of worm drive units **21*a*** and **21*b*** coupled by a common worm shaft **22** which worm shaft in effect represents the torque input shaft of the drive mechanism. A drive motor M is mounted upon and carried by the one worm drive unit **21*b*** for driving the input shaft **22** by way of endless chain and sprocket means indicated at **23**. An overload-responsive device "O" is associated with the base of motor M, all as will be presently described in detail and by reference to the enlarged detailed Fgures 2 to 7.

The drive mechanism **21** is mouned upon the frame **19** which in turn is anchored atop the pier **13** as indicated by anchor bolts **24**. This frame **19** is here shown to be in the general form of a hollow annular casting having an inwardly turned flange **25** whereby it is anchored to the pier. A large annular bull gear **26** of the internally toothed kind surrounds the annular frame **19** and is rotatable thereon by means of an annular vertical thrust ball bearing **27** having a lower ball race **28** constituted by an annular shelf being part of the cast iron frame **19** and extending peripherally thereof as well as outwardly therefrom. The upper ball race designated by the numeral **29** is formed by the bull gear **27** itself.

The annular ball gear **27** constitutes the top end portion of the rake structure **20** which in turn further consists of a central vertical cage portion **30** fastened to the gear **27** as by means of brackets **31** formed thereon, and furthermore of the usual rake arms **32** in the form of horizontal truss structures to which are fastened the conventional sludge conveying blades **33**.

By way of example, for the purpose of this invention, the drive mechanism for the rake structure comprises a pair of drive pinions **34** and **35** engaging the bull gear **26** at diametrically opposed points thereof. These pinions **34** and **35** are driven by respective worm gear units **36** and **37** both of which units are in turn driven by a common worm shaft **38** which constitutes the aforementioned torque input shaft of the mechanism, which in Figure 1 was designated by the numeral **22**. Because of the disposition of the worms at each end the torque input shaft **38** is self-balancing with respect to actual thrust, thus imparting equal shares of drive torque to each of the worm gear units **36** and **37** and thus to each of the drive pinions **34** and **35**.

More specifically, the worm gear drive unit **36** comprises a housing **39** bolted to the frame **19** as at **39*a***. The gearing inside this housing **39** comprises a worm gear **40** rotatable together with the associated pinion **34** through a vertical shaft **41**, and a worm **42** meshing with worm gear **40** having a worm shaft **43** rotatable in the housing **39**.

The worm gear drive unit **37** similarly comprises a housing **44** bolted to a frame **19** as at **44*a***. The gearing inside this housing comprises a worm gear **45** rotatable together with the associated drive pinion **35** by way of an interconnecting vertical shaft **46**, and a worm **47** meshing with worm gear **45** and having a worm shaft **48** rotating in the housing **44**.

The two worm shafts **43** and **48** are in axial alignment with each other and are interconnected by an intermediate length of shafting **49** constituting with the worm shafts **43** and **48** the aforementioned common worm shaft **38** representing the torque input shaft of the mechanism.

The worm shaft **48** has an outer protruding free end **48*a*** which has fixed thereon a sprocket S_1. The common worm shaft **38** is driven by an endless chain element **50**

running over the driven sprocket S_1 from a drive sprocket S_2 shown to be fixed upon the shaft **52** of drive motor M.

With more specific reference to the detail Figures 4, 5, 6 and 7 there will now be described the manner in which this drive motor M is combined with the overload-responsive device of this invention. The motor M has fixed to the bottom thereof an adaptor member or plate **53** whereby it is tiltably mounted upon a base plate **54** which in turn is fixed upon or bolted to the top of the worm gear drive unit **37**. In this way, the motor M is bodily tiltable about an horizontal axis A as represented by an axle **55** extending parallel to the torque output shaft **38** of the mechanism. The axle **55** is fixedly held in lugs **53***a* and **53***b* of the tiltable plate **53** as indicated by a fixing screw **55***a*. This axle **55** in turn is rotatable in bearing blocks **54***a* and **54***b* of the stationary base plate **54**.

In this way, the motor M is tiltable towards and away from the torque input shaft **38**, the near side of the motor facing towards shaft **38**, the far side facing away from that shaft. The motor M is normally spring-urged into an outer limit position such as defined by a set screw **56** provided at the far side of the motor. That is, a compression spring **57** is provided at the near side of the motor between the stationary base plate **54** and the tiltable plate **53** for bodily urging the motor into the far limit position defined by the set screw **56**. An adjusting screw **57***a* is provided upon the tiltable plate **53** for the purpose of adjustably varying the precompression of the spring **57** and thereby varying the point at which it is desired to have the mechanism respond to overload.

The actual response to overload imposed upon the mechanism, which is the overload upon the rotary rake structure **20**, is realized by the provision of suitable monitor means, such as an alarm producing switch, or by the provision of a power cutoff switch device designed to be actuated by the very tilting movement of the drive motor M and contained in a switch box **58** here s' own to be a part of the stationary base plate **54**. Whereas there are conceivable various ways in which a direct mechanical operative relationship between the motor and the overload-responsive switch device can be realized in the sense of this invention, the present embodiment provides in the switch box **58** a stationary switch such as a micro-switch **59** (see Figure 7) together with a switch actuating arm **60** fixedly carried by the axle **55**. Also fixed upon the axle **55** is a stop-arm **61** carrying a stop member in the form of a set screw **62** adapted to hit an abutment **63** at the bottom of the switch box **58**.

It is clear then that the extent of the bodily tilting movement of the drive motor M about the axis A is adjustable in both directions, namely at its outer end by the set screw **56** of the tiltable plate **53** engaging the stationary abutment **56***a*, and at its inner end by the set screw **62** on stop-arm **61** to engage the stationary abutment **63** within the switch box **58**.

I claim:

The combination of a drive mechanism for the pier-supported rotary rake structure of a sedimentation tank, having a frame atop the pier, an annular internally toothed bull gear being part of the rake structure and surrounding said frame and rotatably mounted thereon, powered drive mechanism mounted upon said frame for imparting balanced torque to said bull gear comprising a pair of drive pinions engaging said gear at diametrically opposed points thereof together with balanced torque transmitting means effective to apply equal interbalanced shares of the driving torque simultaneously to the respective drive pinions, with overload-responsive means to become effective at the occurrence of an overload upon the rake structure; characterized thereby that the drive mechanism more specifically comprises a worm gear drive for each drive pinion, disposed above and mounted upon said frame, with a vertical shaft operatively interconnecting each pinion with a respective worm gear drive unit above, and a horizontal shaft extending across said frame and representing a torque input shaft for the drive mechanism to interconnect the worms of said worm gear drive units in a manner whereby torque application to said shaft will impart interbalanced shares of driving torque to said drive pinions, and further characterized thereby that said overload-responsive means comprise an endless drive chain element transmitting torque from said motor to said input shaft, an adaptor member fixed to said motor and movable therewith upon said frame toward and away from said input shaft in the direction of a prescribed path lying in a plane at right angles to said shaft, and adjustable spring means effective to urge the motor base normally in a direction away from the input shaft, and electric switch means mounted adjacent to said adaptor member and adapted to be actuated by said member being urged against spring pressure toward said input shaft by said chain at the occurrence of an overload upon the mechanism.

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