

June 22, 1943.

C. H. SCOTT ET AL

2,322,720

APPARATUS FOR THE TREATMENT OF LIQUID SOLID MIXTURES

Filed March 27, 1942

5 Sheets-Sheet 1

FIG. 1.

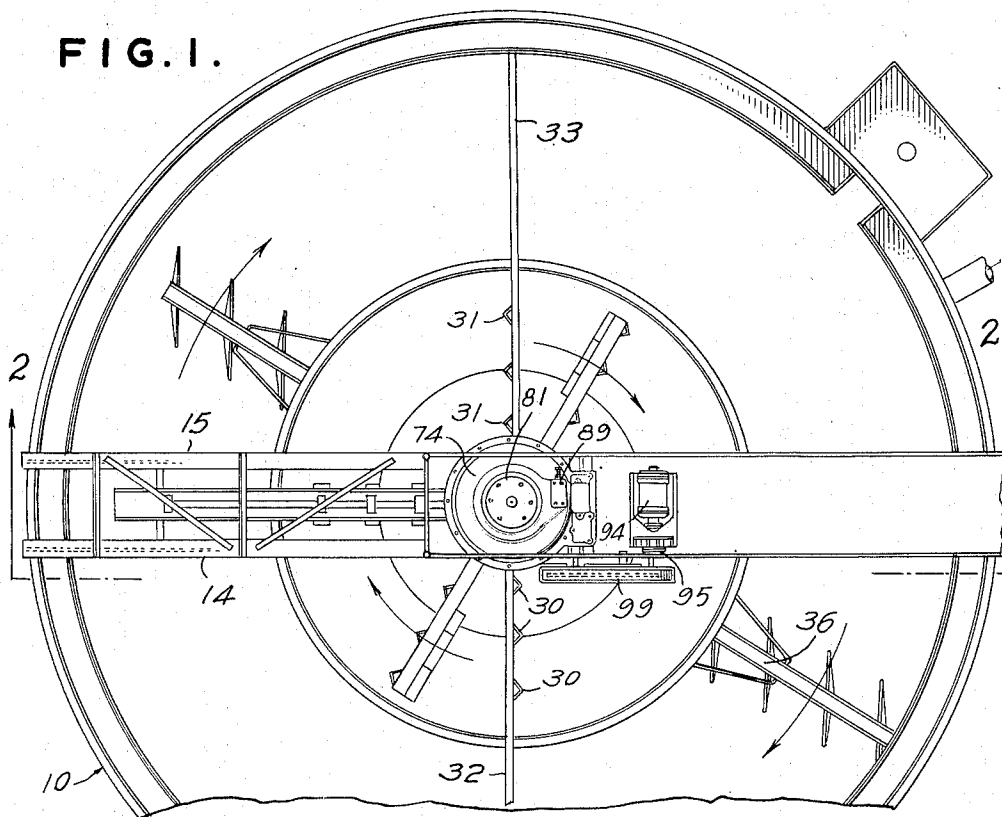
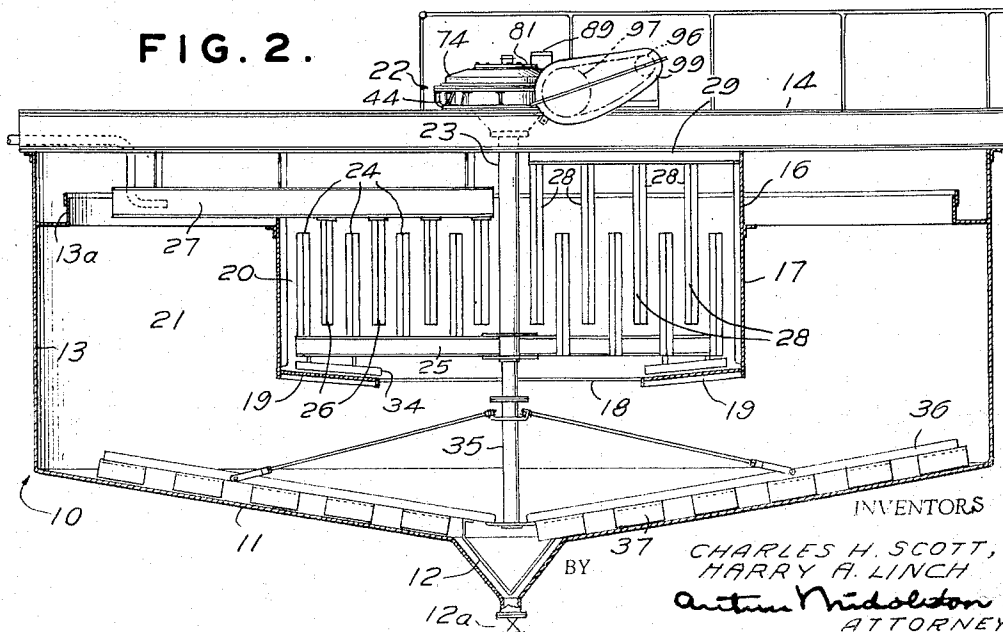


FIG. 2.



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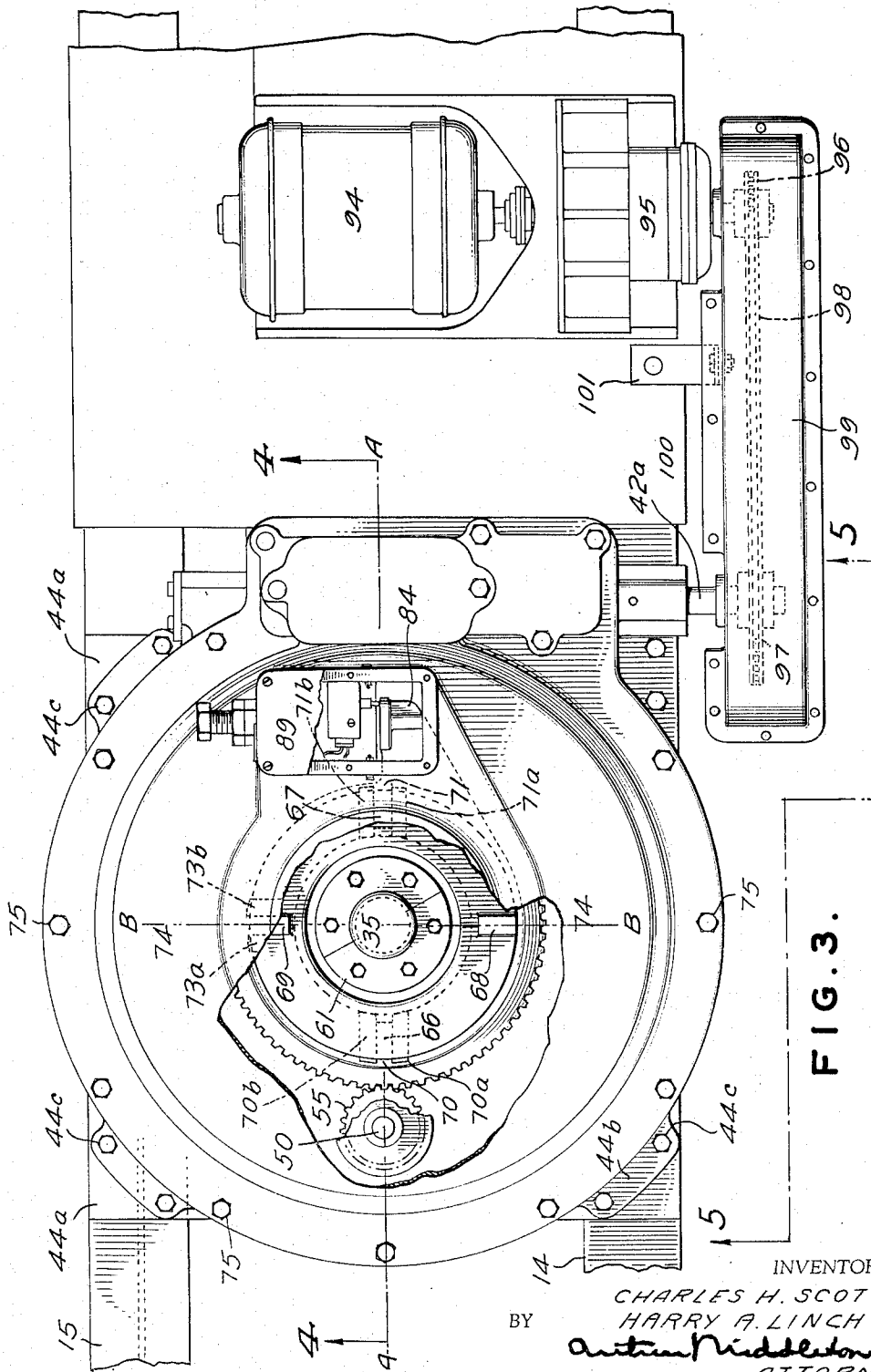
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5 Sheets-Sheet 2



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5 Sheets-Sheet 3

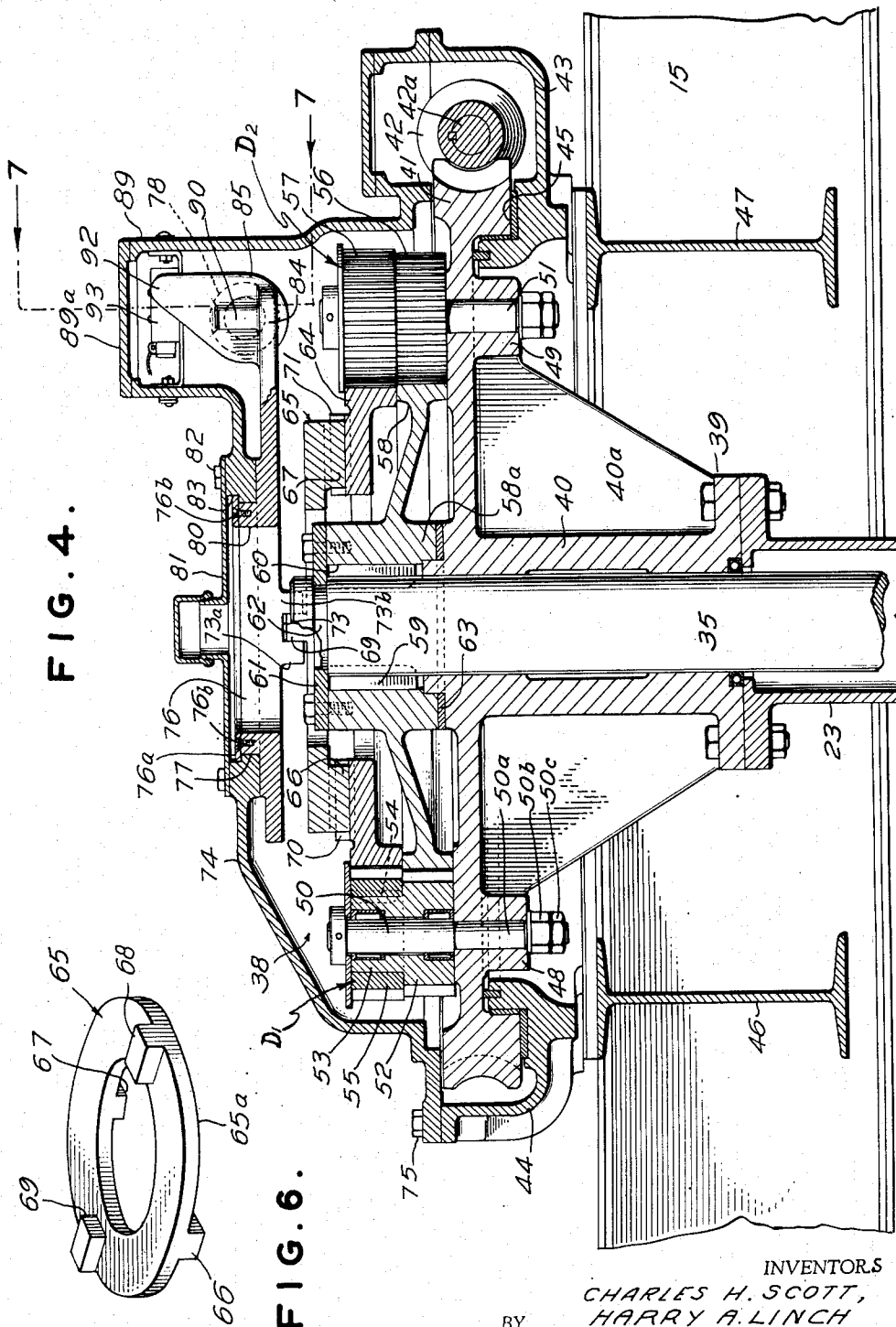


FIG. 4.

FIG. 6.

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2,322,720

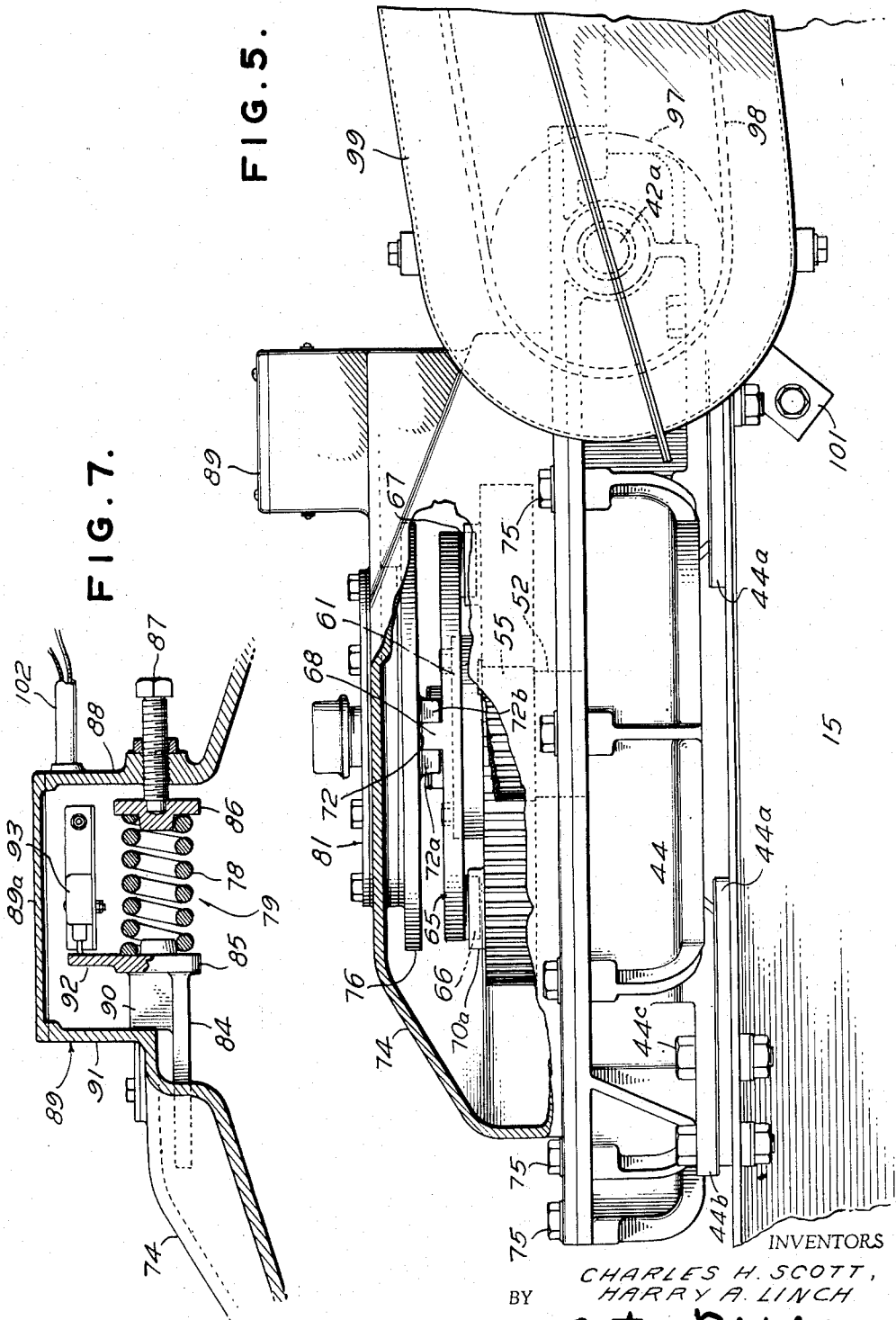
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5 Sheets-Sheet 4

FIG. 5.

FIG. 7.



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APPARATUS FOR THE TREATMENT OF LIQUID SOLID MIXTURES

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5 Sheets-Sheet 5

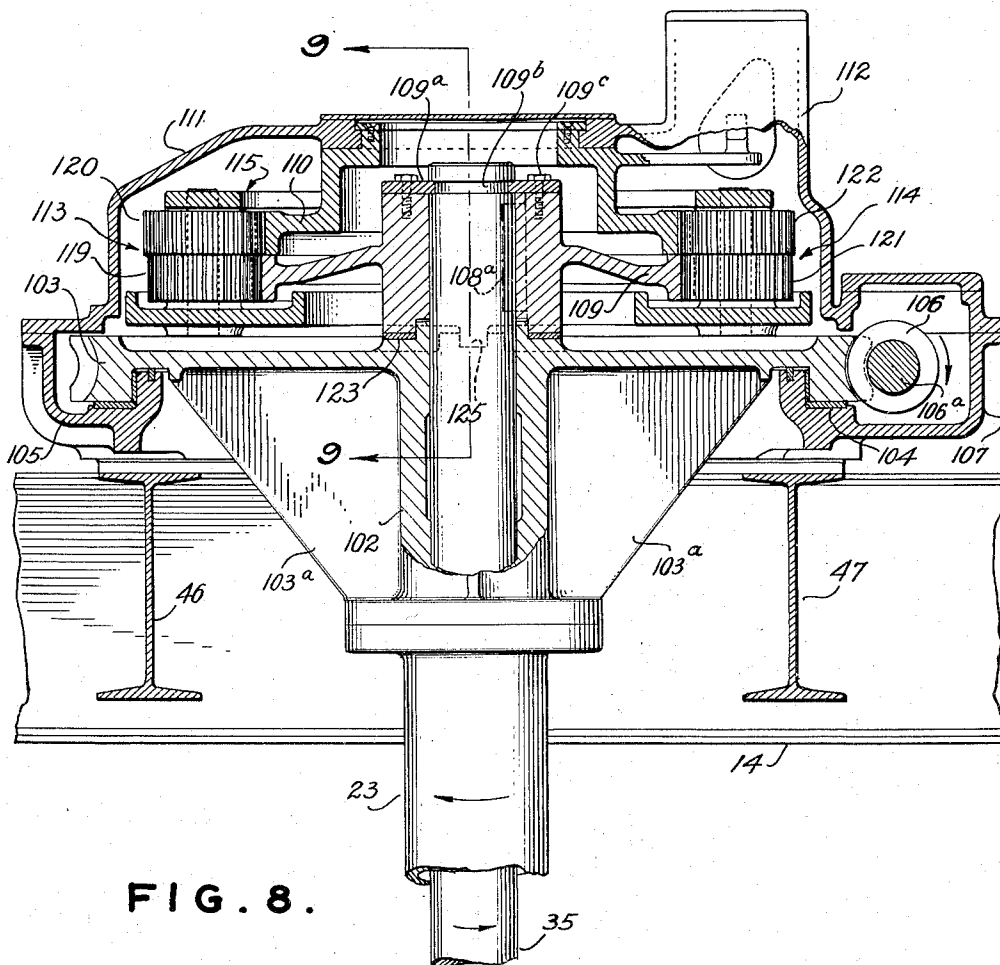
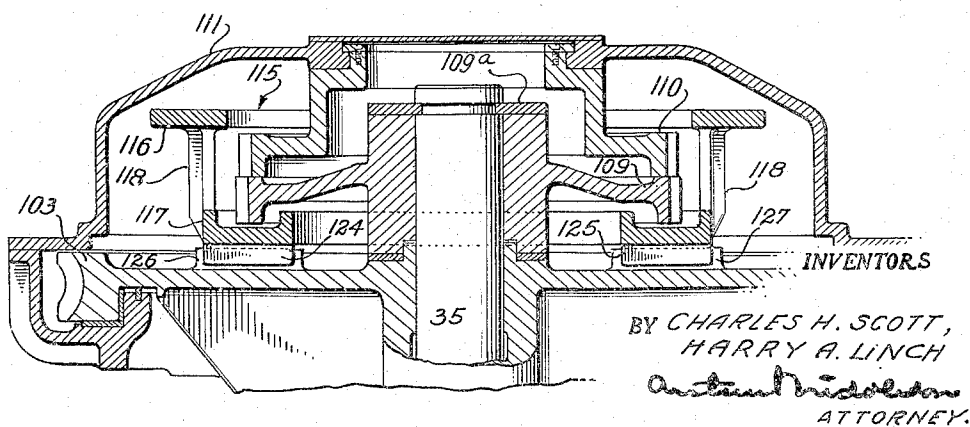


FIG. 8.



UNITED STATES PATENT OFFICE

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APPARATUS FOR THE TREATMENT OF
LIQUID SOLIDS MIXTURES

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Application March 27, 1942, Serial No. 436,450

4 Claims. (Cl. 74—306)

This invention relates to apparatus for treating liquid solids mixtures or suspensions of solids in liquids, by detaining them in a tank while subjecting them to agitation, or to sedimentation, or to both, which apparatus is provided with agitating or sediment raking members or with both, that rotate about a vertical axis in the tank.

In the type of apparatus herein more particularly considered, the tank has an inner, and an outer annular treatment chamber in concentric arrangement, that is, an inner circular chamber is surrounded by an annular chamber, both chambers being provided with members to move therein in a circular path about a common vertical axis, although at differential speeds. Therefore, concentric vertical shafts, that is an inner shaft surrounded by a hollow shaft, are provided, each shaft carrying members which extend into one of the aforementioned concentric chambers to operate therein in circular paths about the common vertical axis.

In a more specific sense, the invention relates to improvements in drive mechanism for the concentric vertical shafts.

It is among the objects of this invention to provide a unitary drive mechanism by means of which both concentric shafts can be rotated at the desired speed differential from a single source of power, such as a motor. Other objects are to provide such a mechanism that is compact with low headroom requirement, simple, inexpensive, and reliable and efficient with respect to operation and power requirements, and that operates smoothly and substantially eliminates shock and vibration, and that is easily serviceable.

In order to attain these objects, the invention provides planetary reduction gearing of suitable ratio for operatively inter-connecting both shafts, one of which is the primary or high speed shaft, and the other is the secondary or low speed shaft. In this way, by driving the high speed shaft at a desired rate from a single motor, the low speed shaft will be rotated at a rate determined by the reduction ratio.

The planetary or reduction gear mechanism comprises a plurality of epicycloidally moving or so-called planetary gears, and it is desirable that the torque load be transmitted from the primary shaft to the secondary shaft substantially evenly through all of the planetary gears at the same time. However, because of manufacturing inaccuracies or unevenness of the gear teeth, such uniform distribution of equal shares of the torque load for each planetary gear is not ordinarily realized, and consequently the torque load shifts

between the planetary gears, thereby reducing the efficiency of the mechanism, increasing the wear and tear, and increasing power consumption. According to the invention, these difficulties are avoided by floatingly mounting some component member or members of the reduction gearing proper in such a manner that the torque loads transmitted through the planetary gears will interbalance. As a result substantially equal shares of the torque load will be transmitted through the respective planetary gears substantially at all times, so that wear and tear are reduced and operating efficiency is increased with attendant decrease in power requirements.

One feature in particular relates to a unit for the treatment of liquids with solids in suspension, in which the said liquid or suspension first enters the inner chamber in order to be subjected therein to flocculation of the suspended solids. The liquid, while being flocculated passes vertically through the inner chamber also called flocculation chamber, and from there it passes outwardly into the surrounding annular chamber where it undergoes sedimentation of the flocculated matter. In this type of unit the two chambers may be said to be defined against each other by a circular wall or partition, the lower end of which terminates a distance above the tank bottom.

In this flocculation-sedimentation unit, the flocculation chamber requires flocculating members or paddles, whereas the sedimentation chamber has rotary sediment raking arms, both the flocculating paddles and the raking arms moving about a common vertical axis, although at differential speeds. The travelling speed of the flocculating paddles being the greater one in terms of rotation of the shafts, these paddles are identified with the primary shaft represented by a hollow shaft member that surrounds the inner or secondary shaft. The secondary shaft is consequently identified with the sediment raking arms. Furthermore, the inner or secondary shaft extends downwardly below the end of the surrounding or primary shaft, and since the circular wall or partition which defines the two chambers against each other, terminates above the bottom of the tank, it is possible for the rake arms to extend from the inner or secondary shaft outwardly over the bottom of the tank unit.

According to this feature a motor driven primary drive gear is unitary and concentric with the vertical primary shaft. A secondary or driven gear is disposed above the motor driven gear and concentric therewith and unitary with the sec-

ondary or inner shaft. Above this and substantially also concentric with the other two gears is provided a non-rotatable gear which is the third gear, and which is of smaller diameter than the secondary gear. The primary or lowermost gear in turn carries a pair of identical rotatable planetary gear units mounted opposite each other on the primary gear. Through these planetary gear units the secondary gear is geared up with the non-rotatable gear above, which makes the mechanism operative so far as the transmission of torque load from the primary to the secondary gear is concerned. Means are provided to permit horizontal floating of the non-rotatable gear relative to the planetary gears in a manner whereby one-half of the drive torque load is inter-balanced with the other half as the load is transmitted through the planetary gear units to the secondary gear.

According to one embodiment the third gear is mounted to float, while the rotary axes of the planetary gear units are fixed relative to the primary gear; according to another embodiment, the planetary gear units are combined in a bodily floating unit, whereas the third gear which is non-rotatable, is fixed and non-floating.

As illustrative of a form of construction by which the invention hereof may be realized, reference is made to the accompanying drawings constituting a part of this specification, and in which drawings:

Fig. 1 is a plan view; and

Fig. 2 is a sectional view taken along lines 2—2 in Fig. 1, of an apparatus for the treatment of liquid-solids mixtures, in which the improved drive mechanism is embodied.

Fig. 3 is an enlarged detail view of the improved drive mechanism.

Fig. 4 is a section along the line 4—4 in Fig. 3.

Fig. 5 is a side view of the drive mechanism taken on the line 5—5 in Fig. 3, with part of the casing broken away.

Fig. 6 is a detail perspective view of a torque equalizing coupling member.

Fig. 7 is a sectional detail view of a torque responsive overload cut-out switch device along the line 7—7 in Fig. 4.

Fig. 8 is the longitudinal section of a modified form of the mechanism.

Fig. 9 is a section on line 9—9 in Fig. 8.

The apparatus embodying the drive mechanism of this invention serves the purpose of first flocculating the solids that are suspended in a supply of liquid, as by agitation in a flocculating chamber or compartment, and then settling the flocculated matter as sediment or sludge under quiescent conditions in a sedimentation chamber or compartment. In the apparatus of this embodiment both treatment compartments are concentrically arranged in a tank, and the flocculating compartment is surrounded by the sedimentation compartment.

The apparatus comprises a tank 10 having a slightly conical bottom 11 provided with a central sludge outlet 12, a sludge discharge valve 12a, and a cylindrical wall portion 13 provided with an annular overflow effluent launder 13a. Across the top of the tank are mounted a pair of beams 14 and 15 from which is supported by means of bracket members 16 a cylindrical partition wall 17 having an annular bottom portion 19 spaced from the tank bottom 11 below and forming a central opening 18. The partition wall 17 defines a flocculating compartment 20 in it, and a sedimentation compartment 21 around it,

Furthermore supported upon the beams 14 and 15 is a rotary flocculating- and sediment-collecting mechanism 22 comprising a primary hollow vertical shaft 23 carrying vertical agitating members 24 fixed upon and rising from horizontally-extending arms 25 fastened on the hollow shaft 23 and rotating therewith. A series of stationary vertical deflector members 26 is shown to be fastened upon and to depend from the bottom of a radially-disposed feed launder 27. Another series of stationary vertical deflector members 28 is fastened upon and extend downwardly from a bracket portion 29 also supported by the beams 14 and 15. Still other vertical deflector members 30 and 31 are supported from corresponding overhead members 32 and 33 respectively which overhead members 32 and 33 incidentally also have brackets 16 depending from them to support the wall 17. The overhead members 32 and 33 extend from the beams 14 and 15 respectively and at right angles thereto in opposite directions and to two diametrically opposite points at the top of the tank 10. The agitator arms 25 have depending from their underside sediment-collecting blades 34 for removing through the openings 18 whatever flocculated matter might have settled upon the annular bottom portion 19.

Within the hollow shaft 23 and concentric therewith operates another vertical shaft 35 herein called the secondary shaft because it rotates at a slower rate than the primary hollow shaft 23, because of the reduction gear ratio between the two shafts and which is part of the drive mechanism to be described.

The secondary shaft 35 carries radially-extending rake arms 36 provided with sediment-collecting plowing blades 37, which shaft 35, when it rotates, will gradually convey sedimented material over the bottom 11 of the tank from the outlying zones thereof to the centrally-disposed sludge outlet 12 for discharge.

Both the primary hollow shaft 23 and the secondary shaft 35 are supported by and depend from the reduction gear drive mechanism proper which mechanism will now be described by reference to Figs. 2, 3, 4 and 5.

The primary hollow shaft 23 is fastened as by flange and bolt connection 39 to the hub portion 40 of a primary gear or worm gear 41 reinforced by ribs 40a and driven by a worm 42 fixed on a worm shaft 42a journaled in the box portion 43 of an annular casing portion or frame 44 in which the worm gear 41 is rotatably supported by means of an annular bearing 45. The annular casing portion 44 is mounted by means of gusset plates 44a upon and supported by the beams 14 and 15 and also by a pair of shorter transverse beams 46 and 47 interconnecting the beams 14 and 15 and constituting therewith a supporting frame. The gear casing 44 has lugs 44b and bolts 44c whereby it is mounted.

Upon the underside of the worm gear 41 there are provided a pair of lugs 48 and 49 diametrically opposed to each other and having fixedly mounted therein gear axles 50 and 51 respectively. Each of these axles carries rotatably thereon a planetary gear assembly in the form of a pair of pinions of differential diameters and keyed together and constituting together with the axle what is herein termed a planetary gear unit in which the upper pinion is somewhat larger than the lower pinion, the ratio being determined by the reduction ratio of the gear as will be more specifically described below. The axle 50 has a reduced portion 50a by means of which it is fitted and seated

in the lug 48, and is held by a nut 50b and a lock nut 50c. The planetary gear assembly or unit rotatably mounted on axle 50 comprises a smaller pinion 52 having an upwardly-extending hub portion 53 upon which is fitted and to which is keyed as at 54 a somewhat larger pinion 55. Similarly the opposite or companion axle 51 has a rotatable planetary gear assembly or unit comprising a lower smaller pinion 56 to which is keyed an upper somewhat larger pinion 57, which planetary gear assembly is identical with that comprising the pinions 52 and 53, and rotatable on axle 51. These planetary gear units each as a whole comprising a smaller and a larger pinion, are identified as D1 and D2.

The two smaller pinions 52 and 56 of the respective planetary assemblies or units mesh with what is herein called the secondary gear 58 because it is fixed to the secondary vertical shaft 35 as by means of key connections 59 and 60, and by a split ring 61 engaging in a groove 62 at the upper end of the shaft 35, the halves of the split ring being fastened to the hub portion 58a of the secondary gear 58, to hold the shaft in place in the hub portion 58a. The secondary gear 58 has an annular bearing 63 upon the primary gear or worm gear 41. Both the larger pinions 55 and 57 of the respective planetary gear assemblies mesh with a stationary or master gear 64 that is held against rotation relative to the stationary gear casing although having limited horizontal play allowing it a floating movement in a horizontal direction at right angles to the center-to-center line of the pinions 55 and 57. In this way the stationary gear 64 can balance itself relative to and between the pinions 55 and 57 so that a substantially equal share of the driving torque load is transmitted from the primary gear 41 through each planetary gear assembly, that is the assembly of pinions 52 and 53 on the one hand, and pinion assembly 56 and 57 on the other hand, to the secondary gear 58.

The means for thus balancing or equalizing the transmission of the driving forces to obtain a balanced driving torque, comprise a floating coupling member 65 (see also detail Fig. 6) in the form of an annular body portion 65a having at its underside a pair of diametrically opposed lugs or teeth 66 and 67, and at its top side a pair of lugs or teeth 68 and 69 also diametrically opposed to each other, but staggered at right angles to the lugs 66 and 67 at the underside. The lugs or teeth 66 and 67 have sliding fit in corresponding grooves 70 and 71 formed by respective pairs of lugs 70a and 70b, and 71a and 71b, provided on the top-side of the stationary gear 64, whereas the lugs or teeth 68 and 69 engage in a similar fashion in corresponding grooves 72 and 73 formed by respective pairs of lugs 72a and 72b, and 73a and 73b, provided upon the underside of the top portion of a gear casing cover 74 that is fastened upon the stationary annular casing portion 44 as by means of bolts 75. More precisely, the upper grooves 72 and 73 are provided upon the underside of an annular member 76 that is rotatably mounted as at 77 in the casing cover 74, but normally held against rotation by a force equalling the driving torque reaction, by a compression spring 78 which is part of an overload cut-out switch device 79 (a detail section of which is shown in Fig. 7). The annular member 76 has an opening 80 and is held in the cover 74 by means of a retaining ring 76a fastened to the annular member 76 by means of counter-sunk screws 76b. A cover plate 81 is bolted as at 82

upon the cover portion 74 of the casing and covers a top opening 83 therein.

The operating relationship between the annular member 76 which may herein be called the torque reaction member, with the overload cut-out switch device 79 is, as follows:

The annular member 76 has an arm 84 provided with a seat 85 for one end of the spring 78 the other end of which is confined by a seat member 86 adjustable by means of an adjusting or set screw 87 that is screwed into the end wall 88 of a box portion 89 which is part of the casing cover 74 and which houses the overload cut-out switch device 79 and is provided with a cover 89a. The spring 78 being adjustably confined between the seat 85 and the seat member 86 will normally cause an abutment portion 90 of the arm 84 to engage the end wall 91 of the box portion 89 thereby determining the normal position of the rotatable annular member 76 while the torque load upon the mechanism does not exceed a maximum that is pre-determined by the adjusted tension of the compression spring 78. However, should an overload make itself felt upon the rake arms 36 due to resistance of sedimented matter encountered by the sediment-collecting plowing blades 37, then the resulting torque reaction will be transmitted from the stationary or master gear 64 through the floating coupling member 65 to the annular torque reaction member 76, and cause a corresponding compression of the spring 78. Simultaneously with the compression of spring 78 in proportion to the torque load reaction, a finger 92 extending upwardly from the seat portion 85 of the annular member 76, will actuate an alarm or cut-out switch 93. Thus an alarm can be sounded or a motor 94 driving the worm 42 will be stopped. Drive means between the motor 94 and the worm 42 are shown to include reduction gearing 95 and a chain drive between the reduction gearing 95 and the worm shaft 42a, comprising sprockets 96 and 97, and a drive chain transmitting driving power from the sprocket 96 to the sprocket 97. The chain drive is enclosed by a housing 99 mounted upon a baseplate 100 by means of brackets 101, the baseplate 100 in turn being mounted upon the supporting beams 14 and 15 and carrying the motor 94 and its reduction gearing 95. Electrical conduit connections for the switch 93 are shown at 102.

The operation of the mechanism according to Figs. 3 to 7, as applied to the treatment apparatus shown in Figs. 1 and 2, is as follows:

A continuous supply of solids in suspension passes through the feed launder 27 and from there enters the flocculation chamber 20 at the top thereof. A liquid thus fed spreads over the area of the flocculation compartment, and while slowly descending through successive horizontal strata, it is subjected to gentle agitation by the vertical agitating member 24 co-operating with and passing by the stationary deflector members 26 and 28, and 30 and 31. The moving members 24 as well as the stationary members 26 and 28 have V-shaped cross-section which promotes a kind of agitation that produces numerous and gentle contacts of the fine suspended and normally unsettleable solids with each other, until they become coagulated into agglomerations or flocs capable of subsequent sedimentation under quiescent condition.

The agitating members 24 move in circular repetitive paths at a speed that is conducive to the formation of the flocs, which speed determines the R. P. M. required of the primary shaft

23 that carries the members 24. The liquid carrying the solids now in the form of flocs continues downwardly and passes through the opening 18 in the bottom of the flocculating compartment 20 into the quiescent space below and around the flocculating compartment, which quiescent space represents the sedimentation compartment 21. Whatever flocs may become lodged upon the annular bottom 19 of the flocculating compartment will be removed by the blades 34 and be caused to join the drifting flow of the other flocs downward through the opening 18. In the sedimentation compartment the flocs are allowed to settle to the bottom 11 of the tank 10 while clarified liquid that is substantially freed of the flocculated solids, is allowed to rise and to overflow into the annular launder 13a. The settled solids on the bottom 11 are engaged by the blades 37 of the rake arms 36 which rotate with the secondary shaft 35. The rotation of the rake arms will gradually convey the settled matter over the bottom 11 towards and into the sludge outlet 12 whence it may be withdrawn through the sludge outlet valve 12a. The rotation of the raking shaft or secondary shaft 35 is required to be much slower than the rotation of the primary shaft 23 that rotates the agitator members. This differential of R. P. M. of the two concentric shafts is taken care of by the reduction ratio that is embodied in the drive mechanism 22.

Generally speaking, the R. P. M. ratio between the two concentric shafts 23 and 35 may be, for instance, over a range from 5:1 to 50:1, but for use with the flocculator clarifier drive herein illustrated in Figs. 1 and 2, a practical range of the ratio may be expected to be approximately from 10:1 to 20:1.

The prime mover for this mechanism is the motor reducer unit 94 and 95 which transmits the driving power from the sprocket 96 through a chain to the sprocket 97 that is herein assumed to rotate the worm 42 in a clockwise direction, thereby rotating the worm gear 41 clockwise when looked upon from the top. This moves the planetary gear assemblies 52, 55, and 56, 57, respectively, bodily in a cyclic path. Since the larger planetary gears 55 and 57, respectively, mesh with the stationary gear 64, and since the planetary gears 55 and 57 respectively are unitary with the respective smaller planetary gears 52 and 56, this bodily movement of the planetary gear assemblies will cause a rotation counter-clockwise of the secondary gear 58 that meshes with the smaller planetary gears 52 and 56. The R. P. M. of the gear 58, of course, is identical with that of the secondary shaft or raking shaft 35.

The torque equalizing floating coupling member 65 is movable in one horizontal direction A—A with respect to the stationary gear 64 by reason of sliding engagement of the lugs 66 and 67 with the grooves 70 and 71, respectively, and it is movable also in a horizontal direction B—B at right angles to the direction A—A but only with respect to the stationary gear housing because of the sliding engagement of the lugs 68 and 69 with the grooves 72 and 73 respectively. In view of this arrangement it is the function of the coupling member 65 to allow and to cause the stationary gear 64 to adjust itself during the operation of the mechanism floatingly in such a manner that an equal portion of the total driving torque will be transmitted from the worm gear

41 through each planetary gear assembly to the gear 58 and thereby to the secondary shaft 35.

While the faster moving agitator members 24 will not encounter any undue torque resistance, it is possible that an undue accumulation of sediment upon the tank bottom 11 will impose an excessive load upon the rake arms 36 and thereby upon the secondary shaft 35, and the excessive resistance thus encountered will react through the gear 58 and the planetary assemblies into the stationary gear 64 which in turn will cause a corresponding excess torque reaction to be transmitted to the torque reaction member 76. This excess torque in turn causes a slight degree of rotation of torque reaction member 76 against the pressure of the spring 78. A sufficient compression of the spring 78, depending upon the amount of excess torque being absorbed by the spring, will allow the finger 92 of the torque reaction member 76 to actuate the switch 93 whereby the drive motor 94 may be stopped, and/or an alarm be sounded.

According to a modification shown in Figs. 8 and 9, the drive mechanism according to this invention is constructed as follows:

The mechanism as a whole is supported upon a beam construction 14, 15, 46 and 47, similar to that previously described in conjunction with the embodiment of Figs. 3 to 6. The primary hollow shaft 23 and the secondary shaft 35 rotating within the hollow shaft, are substantially the same and operate substantially the same with respect to each other, as previously described.

The primary hollow shaft 23 is fastened as by flange connection to the hub 102 of a worm gear 103 that is rotatable upon an annular bearing 104 provided in an annular trough-like portion 105 of a gear casing that is similar to the one shown in the embodiment of the mechanism in Figs. 3 to 6, and this casing is also mounted upon the supporting beam construction in the same manner as shown in the preceding embodiment. The worm gear 103 having stiffener ribs 103a is herein termed the high speed or primary gear in the sense defined in the preceding embodiment, and it is driven by a worm 106 on worm shaft 106a mounted in a box-like portion 107 of the gear casing. Inside the hollow or primary shaft 23 rotates the secondary shaft 35 which is keyed as at 108a to a gear 109 which is herein defined as the low speed or secondary gear of the reduction gear train of this mechanism. A split ring 109a engages in a groove 109b at the top end of the secondary shaft 35, and is fastened to the secondary gear 109 as by screw bolts 109c, for holding the gear 109 against longitudinal displacement upon the secondary shaft 35. Above and coaxial with the secondary gear 109 is provided a stationary master gear 110 mounted in a cover portion 111 of the gear casing, which cover portion is bolted down upon the annular trough-like portion 105 of the casing. The master gear 110 is normally stationary, although it is mounted in the cover portion 111 so as to be rotatable under overload. Normally, however, the master gear 110 is held against rotation, that is, held against the driving torque of the mechanism, by the correspondingly adjusted compression spring of an overload responsive device provided in the box-like portion 112 of the cover portion 111, which device is similar to one shown in Fig. 7.

A pair of planetary gear assemblies 113 and 114 are mounted in an annular cage structure 115 which comprises an upper annular portion

116 and a lower annular portion 117, both annular portions being rigidly inter-connected as by spacer portions 118. Each of the planetary gear assemblies 113 and 114 comprises a lower smaller and an upper larger gear, both the smaller and the larger gear of each assembly being rigidly inter-connected so as to revolve as a unit within the annular cage structure 115, which cage structure in turn rotates together with the primary or worm gear 103 by reason of coupling means to be described. Both planetary gear assemblies 113 and 114 mesh with the secondary gear 109 and with the stationary or master gear 110 at diametrically opposed points thereof, that is to say, a lower gear 119 of the gear assembly 113 meshes with the secondary gear 109, while an upper gear 120, which is somewhat larger in diameter than the gear 119, meshes with the master gear 110. Similarly, at the opposite side, a lower gear 121 that is identical to the gear 119 meshes with the secondary gear 109, while a somewhat larger gear 122 that is identical to the gear 120, meshes with the master gear 110.

The secondary gear 109 has an annular bearing 123 upon the primary or worm gear 103. Coupling means are provided between the annular cage construction 115 and the primary or worm gear 103, that is to say, upon the underside of the cage construction 115 there are provided a pair of guide lugs 124 and 125, each of which has a sliding fit in corresponding grooves 126 and 127, each groove in turn being formed by a pair of lugs provided on the top side of the primary gear 103. The guide lugs 124 and 125 engaging in the grooves 126 and 127 respectively, permit the annular cage structure 115 to adjust itself during the operation of the mechanism, in a horizontal direction along a line perpendicular to a line that extends from center to center of the two gear assemblies 113 and 114.

The operation of the mechanism according to the embodiment in Figs. 8 and 9 is, as follows:

The worm shaft 106a rotating in clockwise direction, turns the primary or worm gear 103 and thereby also the primary shaft 23 in a clockwise direction when looked upon from above. Together with the worm gear 103 rotates the cage structure 115. Since the larger gears 120 and 122 of the two respective planetary gear assemblies 113 and 114 mesh with the master gear 110, it is clear that the somewhat smaller gears 119 and 121 of the respective gear assemblies will drive the secondary gear 109 relative to the primary gear 103 at a reduced speed, that is determined by the differential between the diameters of the secondary gear 109 and the master gear 110, the latter being the smaller one of the two. Consequently, the secondary shaft 35 will rotate countercurrently to the primary shaft 23, namely, in counter-clockwise direction.

During the operation of the mechanism the total driving torque imparted to the primary or worm gear 103 will be transmitted in equal shares by the planetary gear assemblies 113 and 114 to opposite points of the secondary gear 109. Each gear assembly takes substantially one-half the torque load since the planetary gear cage 115 can adjust itself currently in the manner above described, so that inaccuracies or inequalities in the gear teeth will cancel out during the operation. Due to the even distribution of the torque transmitting force evenly to and through both planetary gear assemblies 113 and 114, a true and powerful torque is imparted to the secondary gear 109, relatively low gear pressures

are obtained, the wear and tear consequently reduced, and the mechanism can be made relatively lighter and more compact. Low gear pressures also facilitate the problem of lubricating the teeth.

In case of an undue overload, that is a load in excess of a pre-determined normal operating load or torque imposed upon the secondary shaft 35, the excess torque reaction will cause the master gear 110 to rotate just sufficiently against the spring pressure of the overload responsive device contained in the box-like portion 112 of the casing, to sound an alarm and/or stop the drive motor substantially in a manner described in conjunction with the disclosure of the overload responsive device in Fig. 7.

While an example of the mechanism according to this invention is herein shown to impart differential speeds to the agitator paddles 28, 30, 31, on the one hand, and to the rake arms 36, on the other hand, it should be understood that the invention is not to be limited to this specific embodiment. For instance, the flocculating compartment 20 along with the paddle mechanism therein might be omitted, and the reduction gear drive might serve to impart balanced torque rotation to the shaft 35 alone, for overcoming the sludge raking load.

We claim:

1. A drive gear mechanism comprising a primary gear, stationary means for supporting said primary gear for rotation about a vertical axis, means for driving said primary gear, a vertical shaft, a secondary gear above and rotatably supported by said primary gear and substantially concentric therewith and rotatable relative thereto and connected with said shaft to rotate therewith, a non-rotatable gear above the secondary gear and having substantially concentric relationship therewith and being of different diameter than said secondary gear, stationary structure to provide for non-rotatable mounting of said non-rotatable gear, a pair of oppositely arranged planetary gear units rotatably mounted upon said primary gear, by which units said secondary gear is geared up to said non-rotatable gear thereabove, and means for mounting the non-rotatable gear and the planetary gear units in a manner to permit them to float horizontally relative to one another so as to interbalance the torque loads being transmitted simultaneously through each of said planetary gear units.

2. Mechanism according to claim 1, in which the non-rotatable gear is floatingly mounted, while the position of the rotary axes of the planetary gear units upon and relative to the primary gear is fixed, and in which the means for floatingly mounting the non-rotatable gear comprise a floating coupling member concentric with said non-rotatable gear and interposed between said non-rotatable gear and said stationary structure, means providing coupling engagement of said floating member with said non-rotatable gear to permit horizontally guided floating movement of said gear in one direction with respect to said member, and means providing coupling engagement of said member with said stationary structure to permit horizontally guided floating movement of said floating member with respect to said stationary structure in a direction at right angles to said first mentioned horizontally guided floating movement.

3. Apparatus according to claim 1, in which said stationary structure comprises a housing for the gear mechanism, and in which the non-ro-

tatable gear is floatingly mounted, while the position of the rotary axes of the planetary gear units upon the primary gear is fixed, and in which the means for floatingly mounting said non-rotatable gear comprise a floating coupling member substantially concentric with said non-rotatable gear, and interposed between said non-rotatable gear and the top portion of said housing, means providing coupling engagement of said floating coupling member with the non-rotatable gear to permit horizontally guided floating movement of said gear in one direction with respect to said floating coupling member, and means providing coupling engagement of said floating coupling member with the top portion of said housing to permit horizontally guided floating movement of said member with respect to said top portion of the housing in a direction at right angles to said first mentioned horizontally guided floating movement, with the addition of a member rotatably mounted in the top portion of the housing and substantially concentric with the primary gear and embodying said last mentioned means

for providing coupling engagement, and overload responsive means associated with said housing, comprising means for resiliently absorbing the drive torque reaction imposed upon said member, whereby said member is caused to yield rotatably in response to excess torque imposed upon it, and electric switch means actuated by the yielding movement of the torque reaction member, for stopping the driving power of the mechanism.

4. Apparatus according to claim 1 in which the non-rotatable gear is non-floatingly mounted, and in which the planetary gear units are mounted in an annular body surrounding said primary and said secondary gear, and constituting a bodily floating unit, and in which means are provided for coupling engagement of said floating unit with the primary gear to allow for horizontal self-adjusting movement of said floating unit in a direction at right angles to the center-to-center line of said planetary gear units.

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