Oct. 3, 1961 C. H. SCOTT 3,002,400

RAKE DRIVING MECHANISM FOR SEDIMENTATION TANKS

Filed April 17, 1959 5 Sheets-Sheet 1

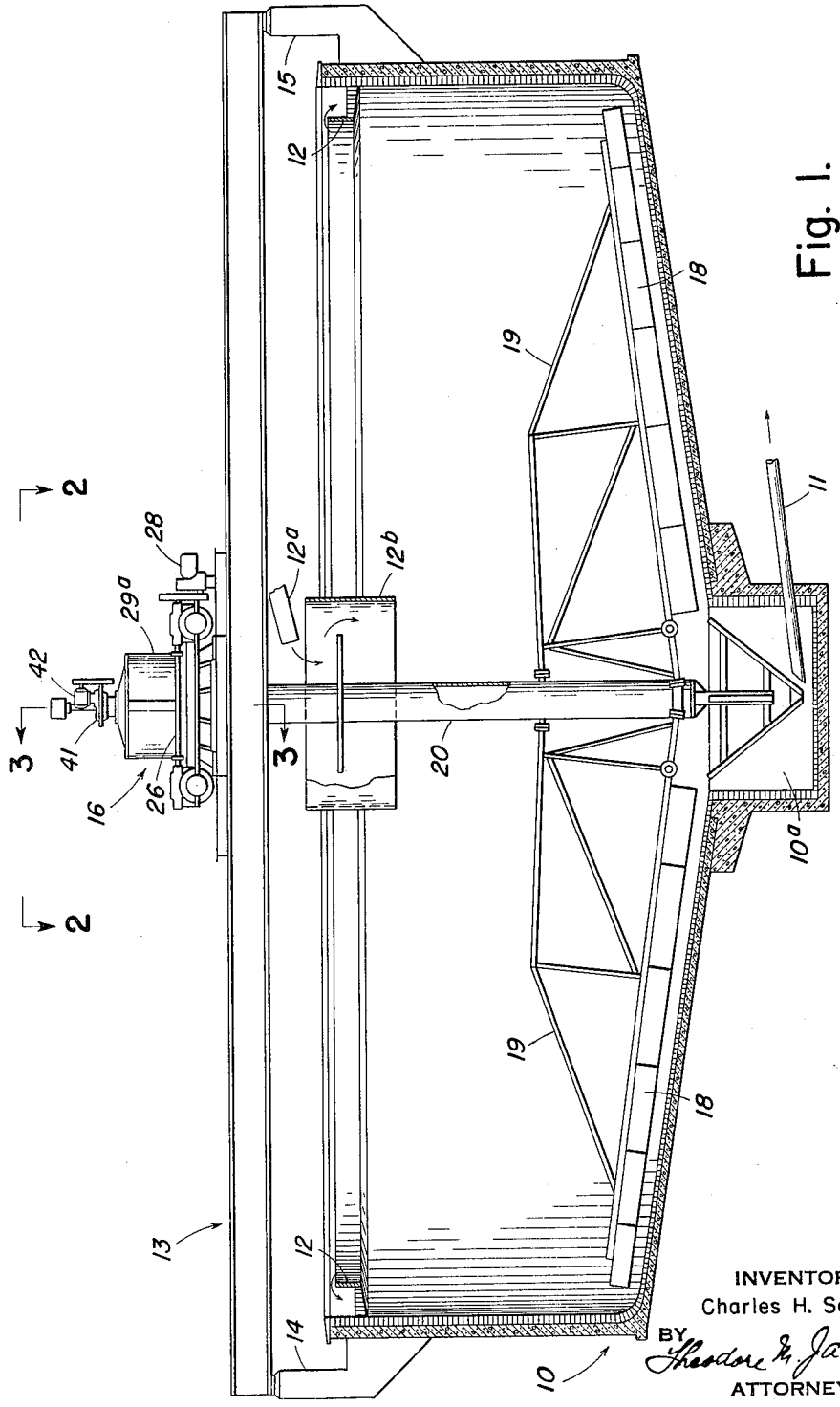


Fig. 1.

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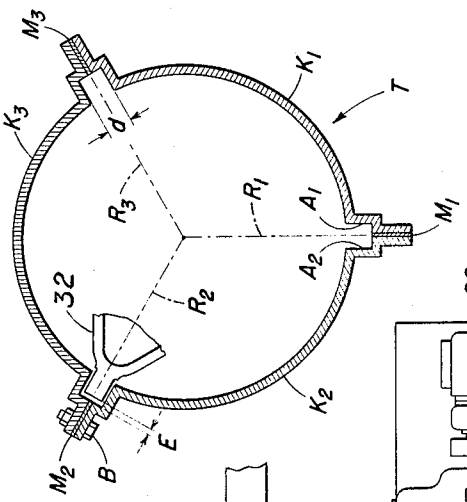


Fig. 4a.

Fig. 2.

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RAKE DRIVING MECHANISM FOR SEDIMENTATION TANKS

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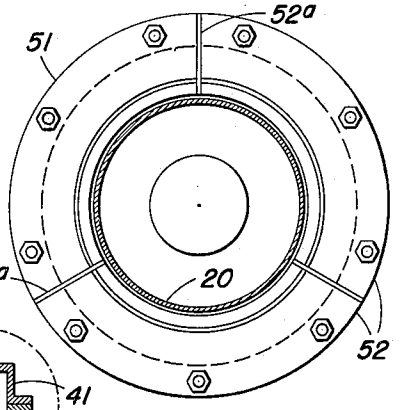


Fig. 3a.

Fig. 3.

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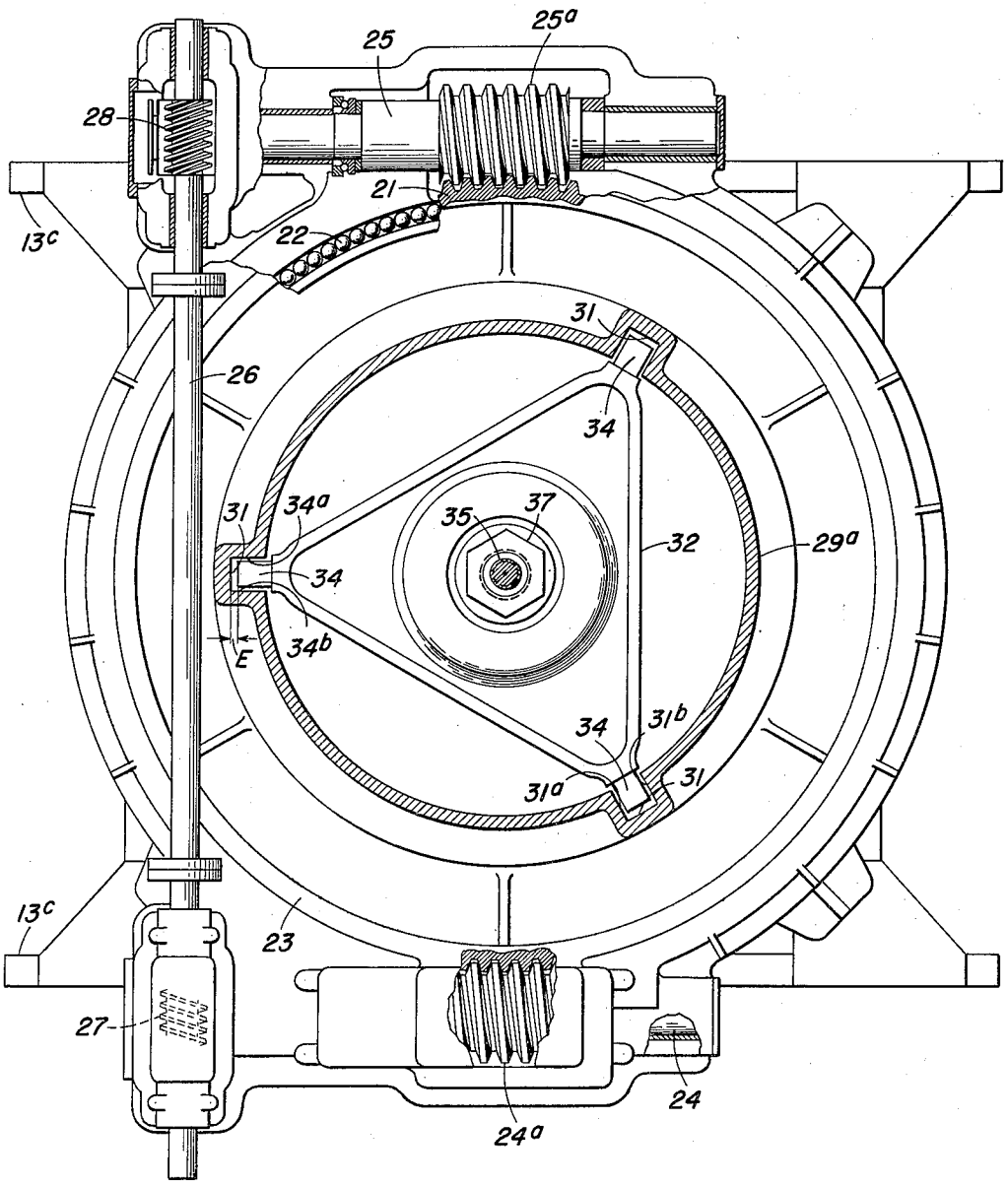


Fig. 4.

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RAKE DRIVING MECHANISM FOR SEDIMENTATION TANKS

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Fig. 5.

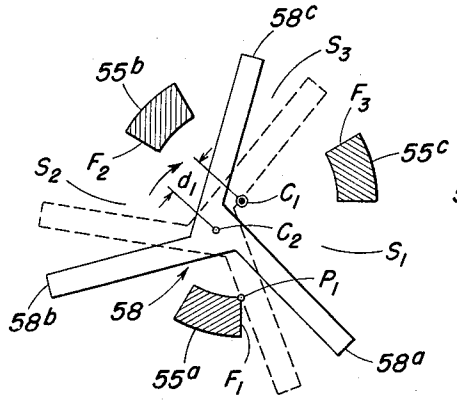
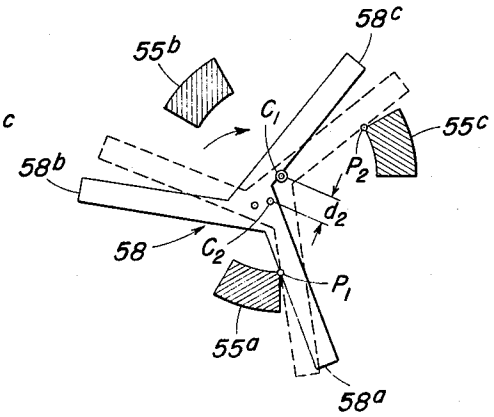


Fig. 6.



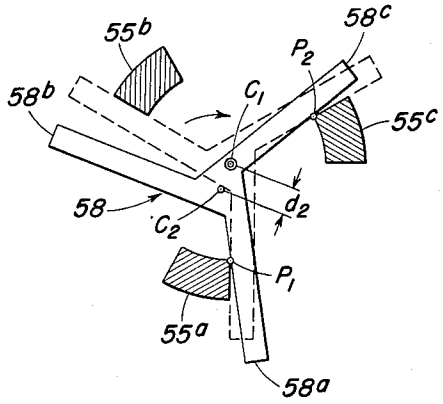


Fig. 7.

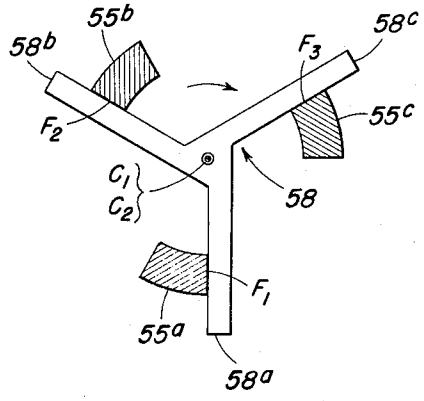


Fig. 8.

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United States Patent Office 3,002,400 Patented Oct. 3, 1961

3,002,400
RAKE DRIVING MECHANISM FOR SEDIMENTATION TANKS

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11 Claims. (Cl. 74—665)

This invention relates to continuously fed sedimentation tanks, and more particularly to improvements in the drive mechanism for the rotary sediment conveying means whereby sediment or sludge is moved continuously over the tank bottom to an outlet means, while supernatant liquid overflows from the tank.

This invention is concerned with improvements in the drive mechanism for rotating a raking structure which has a vertical shaft member supporting bladed sediment engaging means for conveying the sludge over the tank bottom to the outlet means.

In this type of apparatus provision must be made to enable the operator to raise the raking structure from the bottom, whenever necessary, in order to overcome undue sludge accumulation or sludge load on the rakes, thereafter to lower the structure again to its normal operating position relative to the bottom of the tank. Therefore, the drive mechanism comprises a rotary drive member such as a worm gear or the like in which the vertical shaft member must be vertically slideable.

It is one object of the invention to provide an improved and efficient drive arrangement whereby a true or balanced torque is transmitted from the drive member or gear to the shaft, so that the shaft may be shifted freely in an axial direction when raising or lowering the sediment engaging means even while under load from the torque imparted thereto by the drive member or gear and from the sludge load on the rakes.

More particularly, it is among the objects to provide in this type of apparatus extremely simple balanced torque transmitting means of great compactness, ruggedness and stability, preferably with a tubular vertical shaft suited for high torque, and in which the parts are easily accessible and can be readily assembled.

With the foregoing object in view, the improved torque transmitting means between the drive member and shaft member provide triple track means on one of these members with three vertical tracks spaced around the axis of the shaft and co-operating respectively with three radial projections provided on the other member, whereby a balanced torque is transmitted while permitting free axial movement of the shaft member in the driving gear.

In a preferred form of the mechanism, a triple track structure may rise from the gear member surrounding and co-operating with a three-armed torque receiving member which is provided on the shaft. With the torque thus balanced, the shaft is capable of being shifted along the track easily and without binding when either raising or lowering the sediment engaging means.

According to one feature of the invention, the torque transmitting means also serve as a vertical guide bearing for the shaft. Thus the invention provides combined torque transmitting and guide bearing means adapted to co-operate with an additional guide bearing to provide a simple and compact arrangement with vertical stability for the shaft against uneven loads such as might occur on the sediment engaging means.

Another feature lies in the provision of a tubular shaft having flanged connection with the three-armed torque receiving member co-operating with the tracks. The tubular shaft with its flange connection is suited for high torque, with the advantage that the shaft is readily connectable and disconnectable with respect to the drive mechanism.

According to another feature the invention provides lifting means for the shaft, at least part of which means is accommodated in the hollow of the shaft. Preferably a vertical actuating screw spindle for raising and lowering the rake structure is arranged in such a manner that the spindle will telescope into the shaft, thus minimizing the structural height of the mechanism.

Other features and advantages will hereinafter appear.

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

FIG. 1 is a semi diagrammatical vertical sectional view of a continuous settling tank showing the general arrangement of the drive mechanism embodying this invention;

FIG. 2 is a partial plan view somewhat enlarged, taken on line 2—2 of FIG. 1, indicating the triple track feature of this invention;

FIG. 3 is a greatly enlarged detailed vertical sectional view of the drive mechanism itself taken on line 3—3 of FIG. 1, illustrating a preferred embodiment of this invention;

FIG. 3*a* is a detailed bottom view of a guide bearing for the shaft featuring a split arrangement;

FIG. 4 is a cross-sectional view taken on line 4—4 of FIG. 3, illustrating particularly the triple track torque transmitting means, in conjunction with balanced drive means for the drive gear;

FIG. 4*a* shows in reduced scale a modified structure of the torque transmitting means featuring adjustability thereof;

FIGS. 5 to 8 are diagrammatic views illustrating the manner in which the torque transmitting means produce the torque balancing effect attainable by this invention.

As illustrated in FIG. 1, the invention is embodied in a continuously operating settling tank **10** having the central sump **10***a* or the like in which sediment or sludge is collected for discharge through a pipe **11**, and further having the peripheral overflow means or launder **12** for overflow of supernatant liquid. Feed in the form of a suspension of solids enters the tank as through a feed pipe **12***a* delivering the mixture into a feedwell **12***b*.

Diametrically across the tank extends an overhead supporting structure **13** for the drive mechanism, which structure is endwise firmly supported and anchored as upon foundation **14** and **15** respectively. As herein exemplified this overhead construction comprises a pair of parallel structural beams **13***a* and **13***b* inter connected by transverse members **13***c*, supporting a base plate **13***d* or the like for mounting the drive mechanism **16** for the sediment conveying means.

The drive mechanism **16** supports as well as drives a rotary raking structure **17** having sediment engaging means effective to convey the sludge to the central sump for discharge. The sediment engaging means may comprise inclined plowing blades **18** fastened to arms **19** which extend from a vertical shaft member **20** supported by the drive mechanism. As the structure **17** is rotated by the drive mechanism the blades **18** will move the sludge over the tank bottom to the sump. For purposes of this invention, the shaft **20** is preferably in the form of a tube of relatively large diameter suited for handling relatively high torques.

The drive mechanism **16** embodying improved balanced transmitting means comprises a rotary drive

member or worm gear 21 surrounding the upper end portion of shaft 20. The worm gear is rotatable upon an annular thrust ball bearing 22 in a gear housing 23 which is mounted upon the base plate 13*d*. In a preferred embodiment, the worm gear 21 in turn has balanced drive means lending themselves particularly for the purposes of this invention, the gear itself being thereby driven in such a manner that a balanced torque is applied thereto. Accordingly, as indicated in FIG. 1, but most clearly shown in FIGS. 2, 3 and 4, the drive means for the gear 21 comprise a pair of worm shafts 24 and 25 mounted for rotation in the gear housing 23 and having worms 24*a* and 25*a* engaging the gear 21 respectively at diametrically opposed sides thereof. Both worm shafts 24 and 25 are driven by a common shaft 26 disposed transversely of the worm shaft 24 and 25. This common shaft 26 is mounted on the gear housing in such a manner as to have simultaneous driving engagement with shafts 24 and 25 through additional worms 27 and 28 provided on the common shaft and meshing with respective additional worm gears fixed respectively on the worm shaft 24 and 25 but here not visible. The common shaft 26 driven as by a motor 29 is mounted for axial floating movement in both directions insuring that equal shares of the driving torque from the motor are imparted to the worm shafts 24 and 25 which thus imparts a balanced torque to the worm gear 21.

In the preferred embodiment exemplary of this invention, the torque transmitting means between the gear and the shaft comprise a triple track structure in a form of a cylindrical member 29*a* concentric with gear 21 extending upwardly therefrom and fastened thereto as by a flange connection 30.

The track structure 29*a* provides three vertical parallel guide tracks in the form of inwardly facing vertical grooves 31 formed in the track structure, each groove providing a pair of lateral track faces 31*a* and 31*b* opposite to one another. The grooves 31 have open ends 31*c* and 31*d* so that the side faces 31*a* and 31*b* may be readily machined. The guide tracks or grooves 31 cooperate with a three-armed torque receiving member 32 fixed to the top end of the tubular shaft 20 by means of a flanged connection 33. The member 32 has three arms or torque receiving portions 34 extending into respective vertical grooves 31 and having side faces 34*a* and 34*b* adapted to be engaged by the respective track faces of the grooves. The shaft 20 with the sludge raking means is shiftable axially to the extent of the effective length of the guide tracks 31. The terminal portions or projections 34 have a sliding fit in the grooves such as to allow for free axial movement of the shaft.

The shaft is axially suspended by an actuating screw spindle 35 the upper end of which is mounted for rotation, but axially non-shiftable, in a top member 36 removably fastened to the top end of the track structure 29*a*. The lower end of the spindle 35 has threaded engagement with the torque receiving member 32 and thus with the top end of the shaft, preferably by means of a nut 37 mounted in the torque receiving member. The nut 37 is held in the member 32 against rotation therein yet so as to be capable of slight universal tilting movement sufficient to compensate for any inaccuracy of alignment of the spindle with respect to the shaft. Therefore, the nut is held in an adaptor ring member 38 which in turn is flange-connected to the three-armed torque receiving member 29*a*. The lower end of the nut has an annular spherical bearing face 37*b* engaging the adaptor ring member and is secured against rotation in the ring member as by means of keys indicated at 37*a*. The nut is held in place axially by a locking member 39 with sufficient play to allow for the aforementioned slight degree of universal tilting movement.

The actuating screw spindle 35 may be turned by means of a worm drive 40 mounted in a casing 41 carried by the top member 36, and thus bodily rotating with the worm gear 21. A drive motor 42 for this worm drive also rotates bodily with the gear 21 and receives its power supply through slide contacts contained in box 43 carried atop the casing 41.

Preferably the gear 21 is formed with an enlarged downwardly extending hollow hub portion 50 including a slightly conical portion 50*a* and a terminal flange or internal annular shelf 50*b* providing an opening 50*c* large enough to allow the flanged top end of the tubular shaft 20 to be passed therethrough. Fastened to the terminal bottom flange 50*b* is a guide bearing 51 in which the shaft has a sliding fit corresponding to the sliding fit of the torque receiving member 32 in the guide grooves 31. Preferably the guide bearing 51 is split into a suitable number of sectors 52, for example three so that the bearing may be readily removed to facilitate the mounting and dismounting of the flanged shaft with respect to the torque receiving member 32. Also, this split arrangement of the guide bearing allows for adjusting the sliding fit or clearance between the bearing and the shaft by means of radial shims 52*a* interposed between respective sectors 52.

Due to the triple track arrangement of this invention, and with the proper sliding fits provided between the parts, the torque transmitted from gear 21 to the shaft is balanced so that even while under load from the driving torque, the arms 34 will slide readily and without binding on the respective track faces of the grooves whenever the spindle 35 is operated to either raise or lower the sediment engaging means. In this way, the arms 34 will receive equal shares of the driving torque in spite of any manufacturing inaccuracies, inasmuch as the shaft will seek its center of rotation in a manner diagrammatically explained in FIGS. 5, 6, 7 and 8 described as follows:

In order to simplify the explanation, it is assumed that torque be applied to member 58 which has three arms 58*a*, 58*b* and 58*c*, and that these arms transmit torque to respective lugs 55*a*, 55*b* and 55*c* of a member 55.

In FIG. 5, the spaces S1, S2, S3 between the lugs correspond to the vertical guide grooves in the aforementioned track structure 29*a*. The arms 58*a*, 58*b* and 58*c* are shown to extend freely into respective spaces S1, S2, S3 without contacting any of the lugs, while the member 58 itself is shown displaced an exaggerated random distance *d*1 as between centers C1 and C2. Torque T may be applied to member 58 until arm 58*a* touches 55*a* as at point P1 according to the dotted line position of member 58 in FIG. 5.

If torque T is continued according to FIG. 6, the member 58 then turns about point P1 as pivotal center until arm 58*c* contacts lug 55*c* at point P2 in a dotted line position of member 58, whereby the distance small *d*1 between centers C1 and C2 is reduced to the distance indicated as *d*2.

According to FIG. 7, torque T is continued with the result that the member 58 is displaced bodily to find its final center of rotation in which points C1 and C2 will coincide, while the third arm 58*b* contacts lug 55*b* in the dotted line position of member 58.

According to FIG. 8 torque T continues effective to hold the member 58 thus centered and with the arms transmitting equal shares of the torque to the respective lugs 55*a*, 55*b* and 55*c* by engaging respective faces F1, F2 and F3 thereof.

FIG. 4*a* illustrates a feature according to which the space between a pair of track faces is adjustable by means of shims. Accordingly, the track structure T in FIG. 4*a* is subdivided into three sector members K1, K2, K3 as defined by radial plans R1, R2, R3 shown to extend medially through the spaces between respective pairs of track faces A1 and A2. Shims M1, M2, M3 are provided between the respective meeting faces of the sector members, so that the distance between the respective track faces A1 and A2 is adjustable by the choice of

shim thickness. The sector members have vertical flanges associated wth respective track faces, and bolts B are provided for detachably connecting respective vertical flanges to one another to constitute the rigid track structure T. End clearance E (see also FIG. 4) between the end faces of the torque receiving arms and the surrounding torque transmitting member is large enough to allow the shaft member to floatingly adjust itself when torque is applied as illustrated in the exaggerated diagrams of FIGS. 5 to 8.

From the foregoing it will be seen that the triple track arrangement of this invention provides extremely simple, effective, and compact torque transmitting means whereby a balanced torque is applied to the shaft in a manner permitting easy and unhampered sliding movement of the torque receiving member relative to the tracks. A tubular shaft for high torque may be readily connected to the torque transmitting means by means of an efficient torque transmitting flanged connection. Simplicity and compactness as well as operational stability are attained by the combination of the combined torque transmitting and vertical guide bearing means together with the additional guide bearing below. Dismantling of the shaft can be readily accomplished due to the flanged connection together with the split construction of the lower guide bearing means. The structural height of the mechanism is also minimized by the arrangement of the actuating screw spindle so that it will telescope into the hollow of the tubular shaft.

It will be understood that the invention is not limited to the specific embodiment herein shown and described, inasmuch as for example the tracks may be provided on the shaft and the co-operating projections be provided on the driving gear. Also, the triple track structure may extend downwardly instead of upwardly from the gear. Moreover, the concept of the triple-track arrangement for balancing the torque may be employed with or without the additional guide bearing means on the gear. The radial torque receiving projections provided on the shaft member may have bearing faces that are convexly or spherically curved although in the present embodiment plane torque transmitting bearing faces are preferred. The projections may be in the form of self-aligning members mounted movably in such a manner as to insure full working contact between plane torque transmitting bearing faces; for example by being self-adjustable about respective radial axis.

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

I claim:

1. A combined drive and lifting mechanism comprising a vertical shaft member rotatable about its axis, a rotary drive member operatively supported for imparting drive torque to said shaft while allowing for axial movement thereof, said drive member having thereon three upwardly directed vertical guide tracks substantially evenly spaced from one another about the vertical axis of the shaft, actuating means operable for axially raising and lowering said shaft, a driven member having three torque portions cooperative with respective tracks so as to render said driven member self-centering, connecting means for detachably yet rigidly fastening said driven member to said shaft so that there is transmitted a balanced drive torque from said tracks to said driven member simultaneously through said three torque portions thereof, said driven member being free to move vertically upon said tracks when raising and lowering the driven member together with said shaft member, and guide bearing means for said shaft member, carried by said drive member and spaced axially downwardly from said driven member in a direction opposite to said guide tracks.

2. The arrangement according to claim 1, wherein said drive member comprises a gear, a vertical substantially cylindrical open-ended body detachably fastened to said gear, with said guide tracks extending from the extreme lower end to the extreme upper end thereof, and a top member removably fastened to said upper end and providing the upper limit for said tracks.

3. The arrangement according to claim 1, wherein said drive member comprises a gear, and a vertical substantially cylindrical open-ended body detachably fastened to said gear, wherein said vertical guide tracks are formed by inwardly facing open-ended grooves extending from one extreme end to the other extreme end of said body, and wherein said driven member has corresponding radial projections constituting said torque portions and operating in respective grooves, and a top member removably fastened to said upper end and providing the upper limit for said tracks.

4. The arrangement according to claim 3, wherein said cylindrical body is sub-divided into three sector shaped component members defined by radial planes of juncture extending longitudinally through respective grooves with means for detachably connecting said component members with one another.

5. The arrangement according to claim 4, wherein shim means are provided in at least one of said planes of juncture for adjusting the width of respective grooves.

6. The arrangement according to claim 1, wherein said drive member is formed with a hollow hub portion extending downwardly in a direction opposite to said tracks, and wherein said guide bearing means for said shaft member are provided at the bottom end of said hollow hub portion.

7. The arrangement according to claim 6, wherein said guide bearing means comprise a bearing ring sub-divided into a plurality of sector members, and fastening means for attaching each sector member individually to said bottom of the hub portion.

8. The arrangement according to claim 7, wherein shim means are provided between respective pairs of mutually adjoining sector members for adjusting the clearance between said bearing ring and said shaft.

9. A combined drive and lifting mechanism comprising a vertical shaft member rotatable about its axis, a rotary drive member operatively supported for imparting drive torque to said shaft while allowing for axial movement thereof, said drive member having thereon three upwardly directed vertical guide tracks substantially evenly spaced from one another about the vertical axis of the shaft, actuating means operable for axially raising and lowering said shaft, a driven member having three torque portions cooperative with respective tracks so as to render said driven member self-centering, a flange connection for detachably yet rigidly fastening the upper end of said shaft to the underside of said driven member so that there is transmitted a balanced drive torque from said tracks to said driven member simultaneously through said three torque portions thereof, said drive member being free to move vertically upon said tracks when raising and lowering the driven member together with said shaft member, and guide bearing means for said shaft member, carried by said drive member and spaced axially downwardly from said driven member in a direction opposite to said guide tracks.

10. The arrangement according to claim 9, wherein said shaft member is a tubular shaft.

11. A combined drive and lifting mechanism having a vertical shaft member rotatable about its axis, a rotary drive member operatively supported for imparting drive torque to said shaft while allowing for axial movement thereof, a rotary driven member rigidly yet detachably fastened to said shaft, three vertical guide tracks pro-

vided rigidly on one of said rotary members substantially evenly spaced from one another about the vertical axis of the shaft, three torque portions provided on the other rotary member cooperative with respective tracks so that there is transmitted a balanced drive torque from the drive member to the driven member simultaneously through said three torque portions and respective tracks, with said driven member thus rendered self centering, and free to move vertically upon said tracks when raising and lowering the driven member together with said shaft member, and said tracks functioning as guide bearing and also as a torque transmitting means, and guide bearing means for said shaft member, carried by said drive member and spaced axially downwardly from said driven member in a direction opposite to said guide tracks.

References Cited in the file of this patent

UNITED STATES PATENTS

76,819	Ross	Apr. 14, 1868
867,958	Dorr	Oct. 15, 1907
1,117,505	Kingsbury	Nov. 17, 1914
1,303,618	True	May 13, 1919
1,363,113	Harris	Dec. 21, 1920
1,509,677	Lees	Sept. 23, 1924
2,239,194	Fitzgerald et al.	Apr. 22, 1941
2,360,817	Scott	Oct. 17, 1944
2,473,307	Seipt et al.	June 14, 1949
2,724,506	Hardinge	Nov. 22, 1955