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Dancs

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[54] **FLUID DRIVE MEANS**

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[51] **Int. Cl.²**.. **F01B 7/04**; F15B 11/18; F15B 13/07

[58] **Field of Search** ..... 91/314, 210, 414, 129; 92/68, 118, 14 C, 161

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Primary Examiner—Paul E. Maslousky

[57] **ABSTRACT**

A fluid drive device for high torque, low speed applications.

11 Claims, 5 Drawing Figures

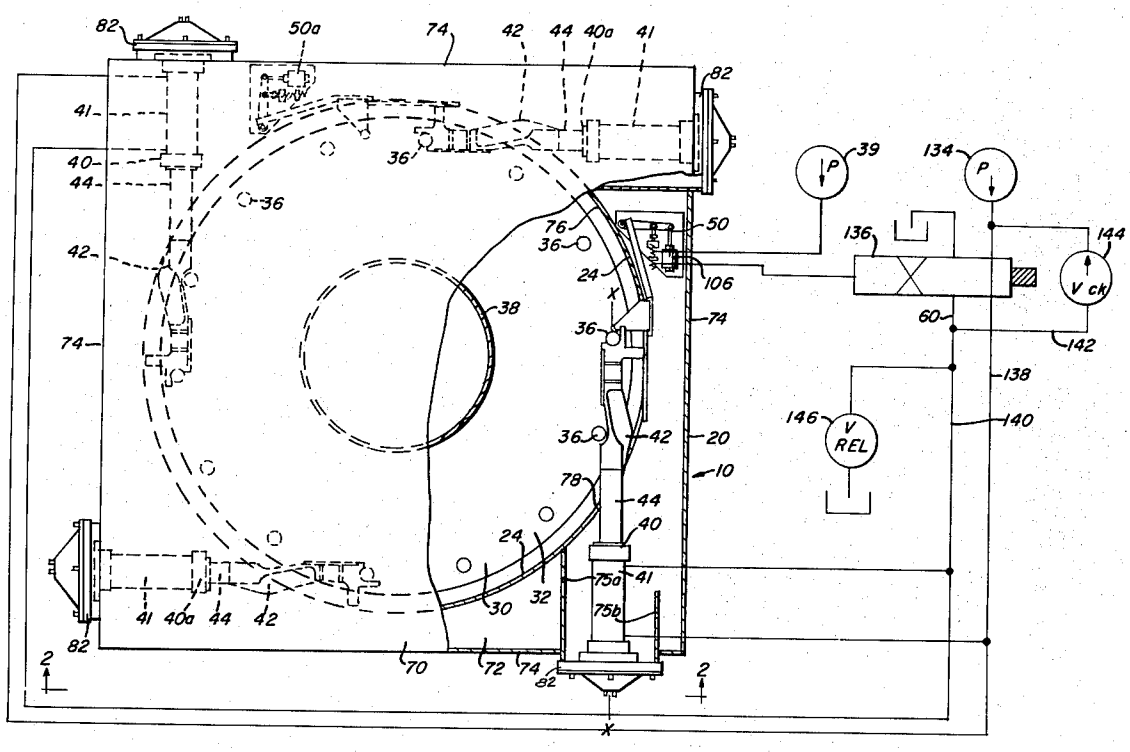


FIG. 1

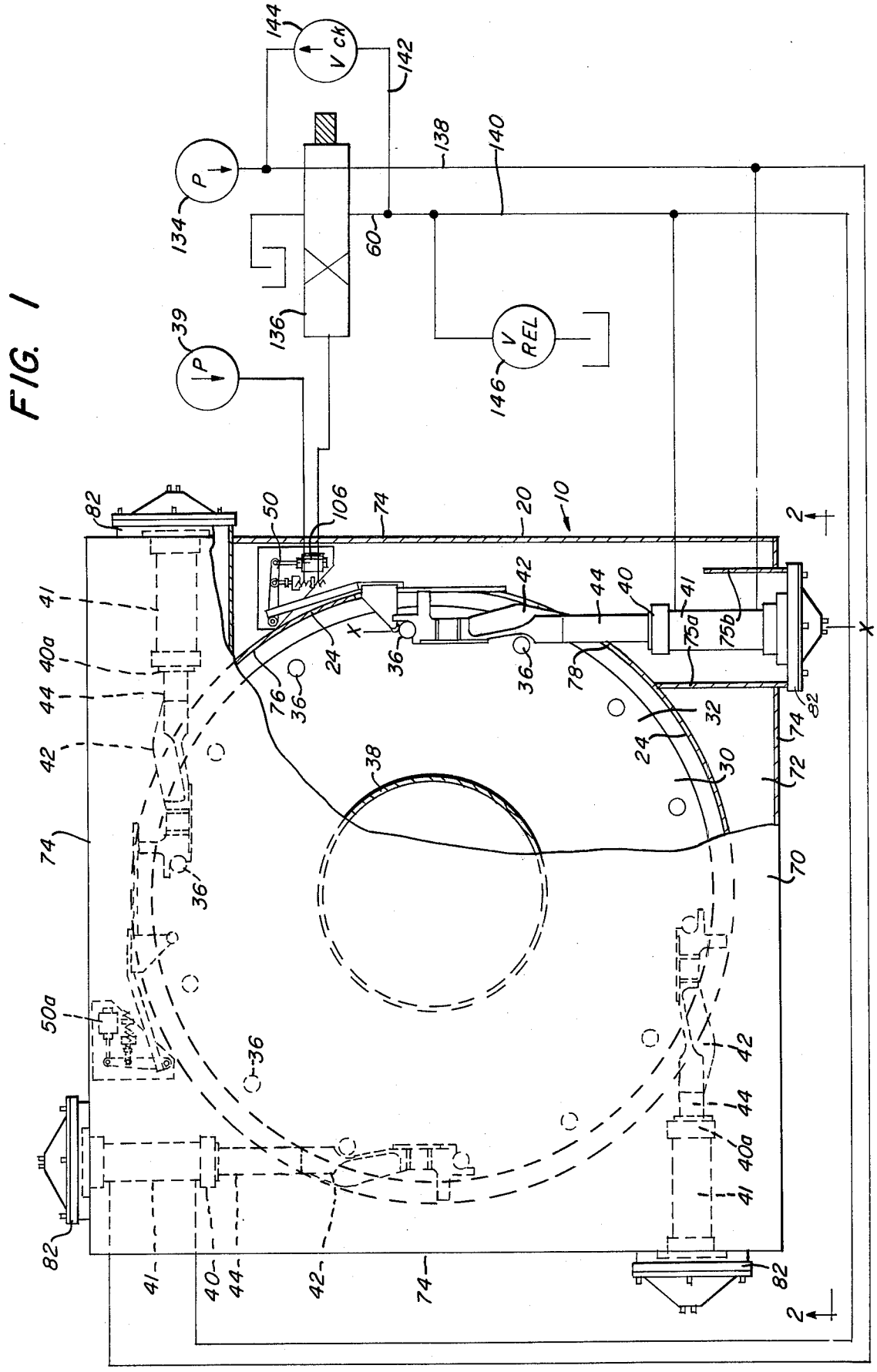

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40a
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75a
75b
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50a
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FIG. 2

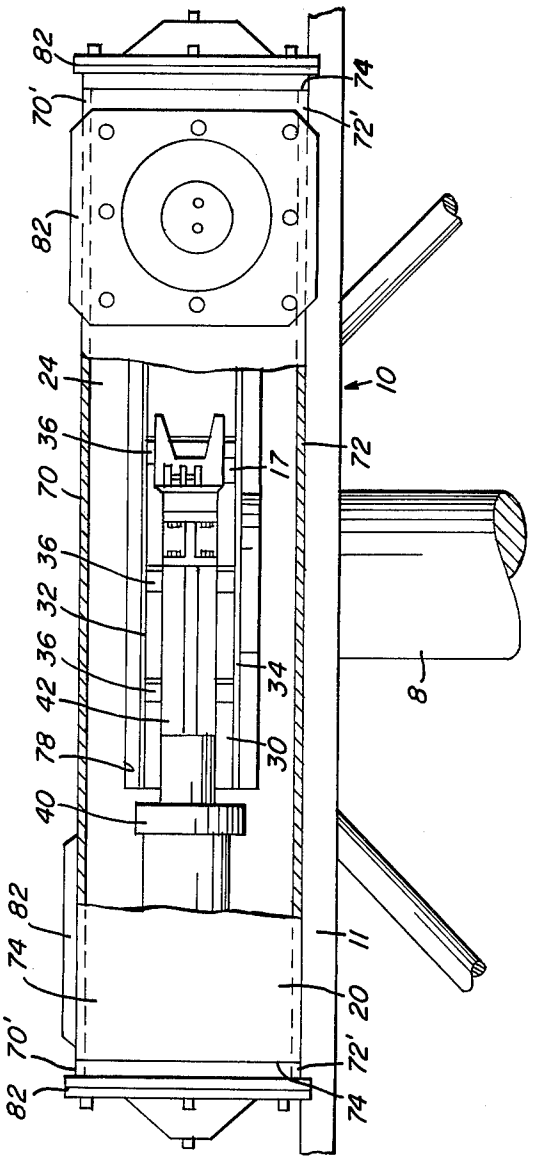

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FIG. 5

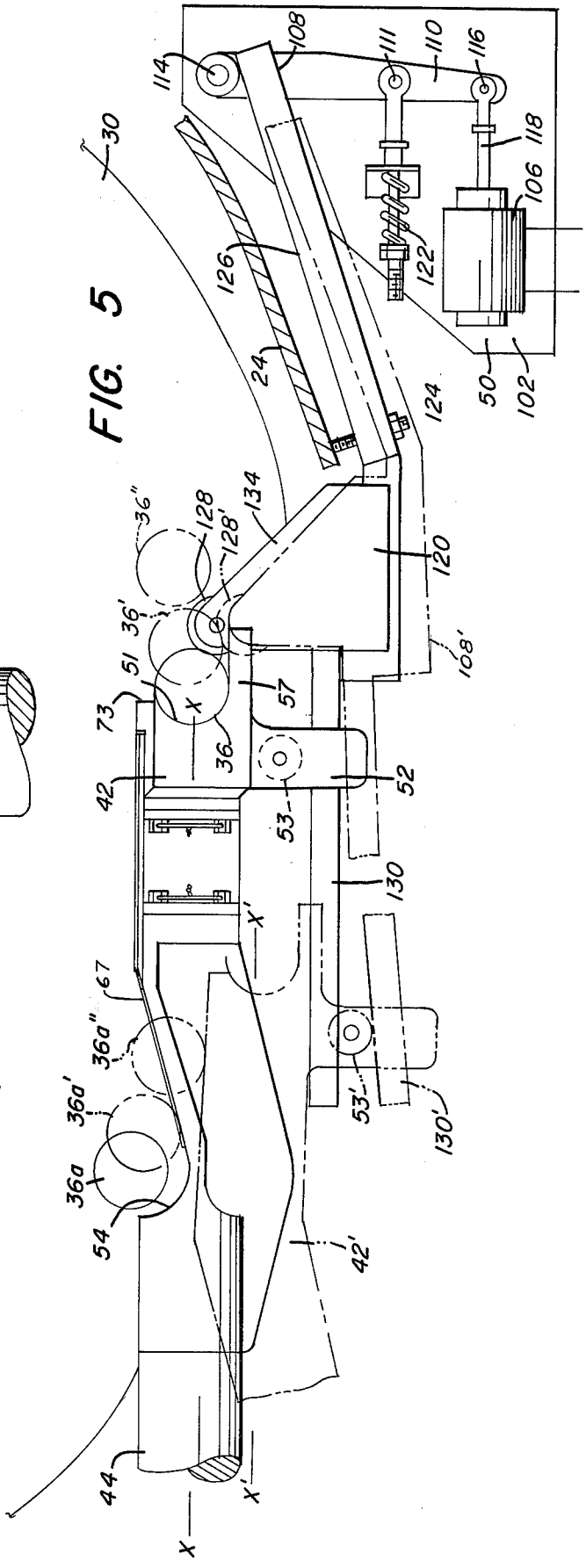

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X'
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FIG. 3

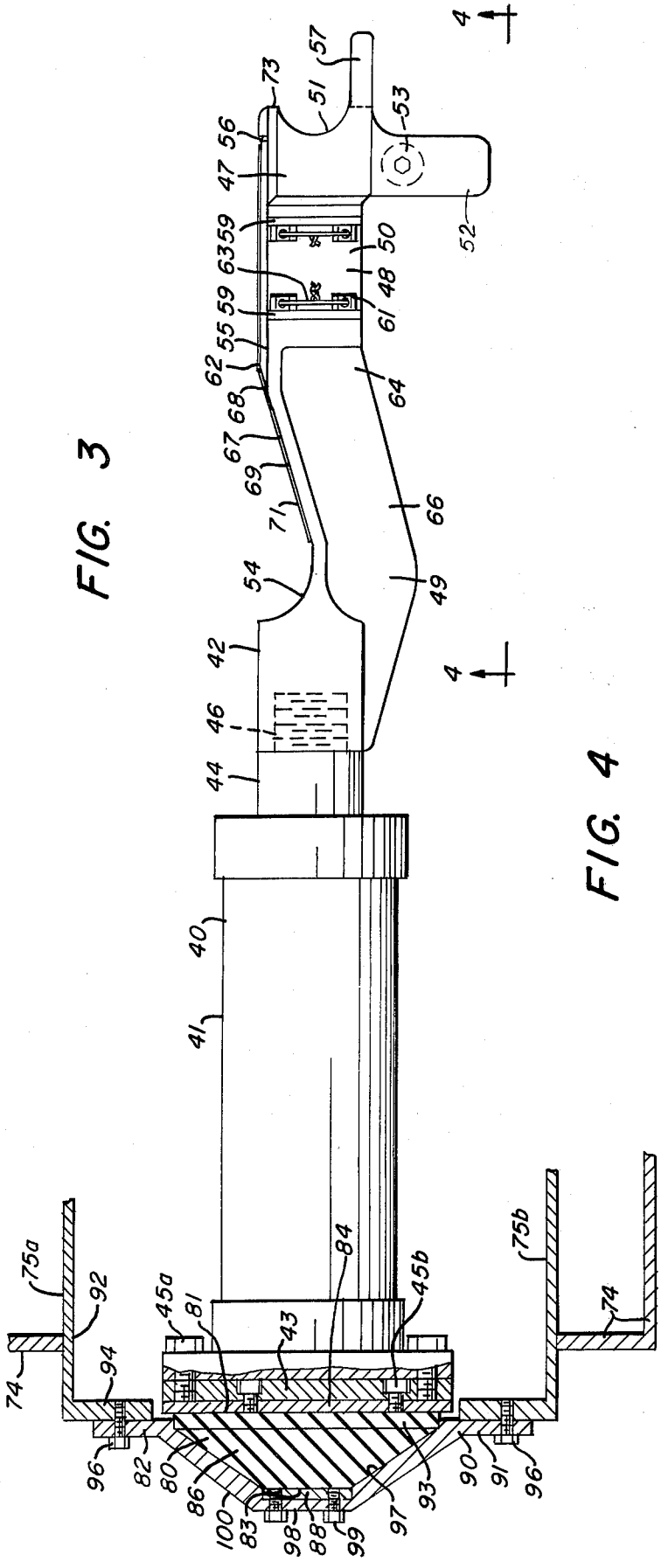
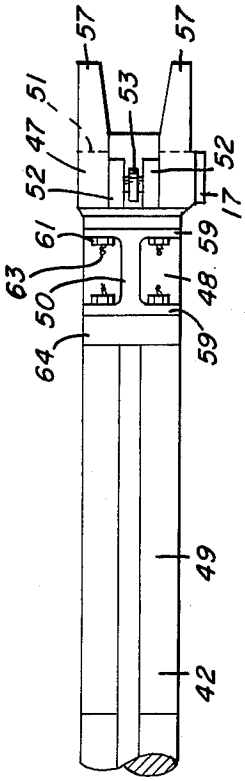

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FIG. 4


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FLUID DRIVE MEANS

In the art of rotating apparatus fluid powered drive mechanisms have been used to drive large rotating equipment such as large diameter thickeners and settlers and like equipment which must receive power at extremely high torque values for rotation at very low speeds. one such fluid drive mechanism comprises a plurality of hydraulically actuated driving arms disposed generally tangentially to a driven ring or wheel portion of the apparatus to be rotated thereby and intermittently engageable therewith in the manner of a ratchet and pawl mechanism. In practice selected ones of such driving arms engage the ratchet wheel for a power stroke to incrementally rotate the driven apparatus while other selected driving arms simultaneously end a previous power stroke thereof, disengage from the ratchet wheel and are repositioned to reengage the ratchet wheel for a subsequent power stroke. The alternating incremental rotations thus produced rotate the driven apparatus in a smooth, continuous manner. Such a drive system may be constructed so as to provide very low rotational speeds on the order of **0.01** to **10** revolutions per hour at very high torque capacities, for example up to and well in excess of one million foot pounds.

The present invention is an improved fluid drive of the type specified having such advantages over similar known mechanisms as for example a simplified elastomeric mounting which affixes a driving arm assembly in the operational position thereof and renders such assembly laterally movable with respect to the driven ratchet wheel. The improved mounting is operable without recourse to other conventional supports such as pin connections, ball and socket joints, springs and like elements customarily used in the prior art. Additionally, the improved mounting is highly wear resistant and requires no lubrication.

The present invention additionally includes an improved driving arm having cam means adjacent respective inner and outer sides thereof which are cooperable with the driven ratchet wheel and with a control valve means to control operation of the drive device.

These and other objects and advantages of the present invention are more completely specified in the following description and illustrations in which:

FIG. **1** is a top plan view, partly in section and partly schematic of a fluid powered drive mechanism constructed in accordance with the principles of the present invention;

FIG. **2** is a side view, partly in section, of the fluid drive of FIG. **1** substantially as seen from line **2—2** of FIG. **1**;

FIG. **3** is an enlarged fragmentary portion of FIG. **1**, partly in section, illustrating an actuating cylinder and driving arm assembly and a mounting therefor constructed in accordance with the principles of the present invention;

FIG. **4** is a side view of the driving arm of FIG. **2** substantially as seen from line **4—4** of FIG. **3**; and

FIG. **5** is an enlarged fragmentary portion of FIG. **1** illustrating a driving arm and a control valve assembly of the present invention including selected operational positions thereof illustrated diagrammatically.

There is generally indicated at **10** in FIGS. **1** and **2** a fluid powered drive mechanism constructed in accordance with the principles of the present invention and presumed for purposes of illustration to be of a type utilized to power such large rotating apparatus as a large diameter thickener or clarifier. Such apparatus is well known to those versed in the art and therefore is not shown as exhaustively described herein inasmuch as such description is not necessary for an understanding of the present invention. Suffice it to note in this regard that in practice the drive **10** is disposed atop a thickener tank (not shown) and adapted to drivingly engage one end of a rotatable shaft **8** extending vertically therewithin and having rake arms or the like (not shown) affixed adjacent its opposing end within such a thickener tank whereby drive **10** powers the rake arms in rotation in a well known manner and for such customary purposes as for example the separation of solid components from a liquid mixture. It is of course to be understood that the drive **10** of the present invention may be utilized to rotate various other types of rotating equipment about vertically or horizontally disposed axes, for example a center pier type thickener or clarifier or a large horizontally disposed rotating drum type diffuser, and therefore should not be construed as being limited to the illustrative application described herein.

Drive **10** comprises: a generally rectangular housing **20** rigidly carried by a well known truss or bridge **11** spanning the diameter of the thickener tank and rigidly affixed thereto; a ratchet wheel **30** rotatably carried within the housing **20** and drivingly engaging the shaft **8**; cooperable driving assembly pairs **40** and **40***a* which include driving arms **42** rigidly affixed adjacent the forward ends thereof, the arms **42** extending substantially tangentally to the wheel **30** and adapted to intermittently engage selected peripheral portions thereof; and valve means or control assemblies **50** and **50***a* rigidly disposed within housing **20** and cooperable with selected ones of arms **42** to control the assemblies **40** and **40***a* through a suitable hydraulic actuating circuit **60.**

The housing **20** is a rigid structure shown as comprising a pair of generally rectangular plate-like upper and lower members **70** and **72,** respectively, disposed in vertically spaced parallel relation as illustrated in FIG. **2** and retained thereat by a plurality of wall portions **74** extending vertically intermediate members **70** and **72** and rigidly affixed thereto adjacent outer peripheral portions thereof. The wall portions **74** are rigidly affixed together at respective corners of members **70** and **72** so as to form an outer peripheral portion of the housing **20.** Housing **20** additionally includes a circular inner peripheral portion **76** encompassed by a wall portion **24** extending vertically intermediate and rigidly affixed to members **70** and **72** and adapted to receive wheel **30** therewithin, and a plurality of driving assembly mounting portions **82** rigidly affixed outwardly adjacent wall portions **74** and adjacent respective corners of housing **20,** and adapted to receive respective mountings **80** (FIG. **3**) of assemblies **40** and **40***a*.

In FIGS. **1** and **2** wheel **30** is shown as comprising a pair of circular plate-like upper and lower members **32** and **34** rigidly retained in vertically spaced parallel relation such as by a wall portion **38** extending intermediate members **32** and **34** adjacent an inner peripheral portion thereof. A plurality of circumferentially spaced cylindrical pins **36** extends axially intermediate members **32** and **34** and are rigidly affixed therebetween adjacent an outer peripheral portion thereof.

The wheel **30** is rotatably carried within portion **76** of housing **20** by suitable bearing means (not shown)

such as a well known turntable bearing or the like and suitably adapted such as by splines (not shown) to drivingly engage an upper end portion of the shaft **8.** The respective arms **42** of assemblies **40** and **40***a* intermittently and drivingly engage pins **36** in a ratchet-like manner such that the wheel **30** is powered in rotation thereby.

Referring now to FIG. **3** there is depicted one of driving assemblies **40** shown as comprising a hydraulically actuated cylinder assembly **41** including a piston (not shown) slideably carried therewithin to which is affixed one end of a piston rod **44.** One of arms **42** is suitably rigidly affixed as by mating threads **46** adjacent the opposing end of rod **44.** Each assembly **40** is retained by a respective mounting **80** adjacent one of assembly mounting portions **82** of housing **20.** It is to be understood that assemblies **40***a* are identical in every respect to assemblies **40.** Accordingly, the description hereinabove and hereinbelow regarding structure and operation of the assemblies **40** also applied to assemblies **40***a*.

Each mounting portion **82** includes an annular flange **94** spaced outwardly from wall portion **74** and rigidly affixed thereto as by portions **70'** and **72'** of members **70** and **72** (FIG. **2**) extending therebetween and by support members **75***a* and **75***b* also extending therebetween and further extending inwardly of wall portion **74** intermediate members **70** and **72** and rigidly affixed thereto (FIGS. **1** and **3**). A space **92** to receive the driving assembly **40** into mounting portion **82** is formed intermediate adjacent support members **75***a* and **75***b*.

Flange **94** carries a generally frustoconical assembly mount retaining member **90** comprising: a transverse annular flange portion **91** which is adapted to be rigidly affixed adjacent flange **94** such as by bolts **96** or by weldments (not shown); a transverse assembly mounting retaining portion **98** spaced rearwardly from flange **91**; and a tapering intermediate portion **100** extending intermediate portions **91** and **98** which receives adjacent a tapering inner surface **97** thereof the mounting **80.**

Each mounting **80** includes a generally frustoconical body member **86** formed from a suitably resilient elastomer such as rubber and having forward and rearward faces **81** and **83,** respectively. The faces **81** and **83** are bonded to respective forward and rearward rigid mounting plates **84** and **88** to form the substantially unitary mounting **80.**

In assembly, the mounting **80** extends intermediate member **90** of portion **82** and the rearward end of hydraulic cylinder **41,** the forward plate **84** thereof being rigidly and releasably affixed adjacent the rearward end of cylinder **41** as for example by a suitable adaptor plate **43** rigidly secured therebetween such as by bolts **45***a* and **45***b* or the like, and the rearward plate **88** thereof being rigidly and releasably affixed adjacent portion **98** of member **90** as by screws **99.** In this configurationi configuration body **86** is captively retained within member **90** adjacent the mating tapered surface **97.** An offset portion **93** of body **86** located rearwardly adjacent forward face **81** provides clearance between adaptor plate **43** and flange **91** and is free to bulge laterally to absorb axial loads imposed upon the assembly **40.**

The assembly **40** thus mounted extends inwardly intermediate support members **75***a* and **75***b* on an axis X—X (FIG. **1**) such that arm **42** thereof extends through a respective opening **78** in wall portion **24** and substantially tangentally to the wheel **30.** By virtue of the inherent resiliency of body **86** assembly **40** is laterally movable with respect to the axis X—X for purposes to be described hereinbelow.

By reference to FIGS. **3** and **4** it is seen that the arm **42** comprises: a rigid forward end or jaw portion **47**; a rigid elongated support portion **49** spaced rearwardly therefrom; and a relatively flexible intermediate portion **48** extending longitudinally between portions **47** and **49** and rigidly affixed thereto. The arm portions **47,** 48 and **49** have inward and outward side surfaces **62** and **64,** respectively, extending longitudinally thereon intermediate the longitudinal ends of arm **42.**

Jaw portion **47** includes: a jaw **51** adjacent the forward end thereof suitably formed to be engageable with pins **36** and having a lip **73** formed adjacent inward side **62**; a bifurcated end portion **57** which extends forwardly of jaw **51** adjacent outward side **64**; a bifurcated guiding or cam portion **52** rigidly affixed intermediate the longitudinal ends of portion **47** adjacent outward side **64** and extending outwardly therefrom; and a camming or guiding roller **53** rotatably carried intermediate the legs of portion **52.** Jaw portion **47** additionally includes a bearing or support surface portion **17** disposed intermediate the longitudinal ends of portion **47** adjacent a lower side thereof and adapted to support the forwardmost end of the assembly **40** by bearing in sliding engagement upon a peripheral portion of wheel member **34** outwardly adjacent pins **36** (FIG. **2**).

Support portion **49** includes: an outward offset or bend **66** intermediate the longitudinal ends thereof; a notch **54** formed in inward side portion **62** inwardly adjacent offset **66**; and an inwardly slanting portion **71** of inward side **62** extending intermediate notch **54** and a point **68** spaced forwardly therefrom.

Intermediate portion **48** as shown includes a longitudinal web portion **50** disposed substantially in a horizontal plane, and transverse flanges **59** rigidly affixed to the longitudinal ends of web **50** and suitably secured to respective adjacent ends of portions **47** and **49** such as by screws **61** and lockwires **63** or the like. The portion **48** is designed to be relatively more flexible than arm portions **47** and **49,** it being formed from any suitable high strength material having a relatively low modulus of elasticity, for example aluminum. Additionally, the relatively thin section presented by web **50** provides a degree of vertical bending capacity not offered by comparatively rigid arm portions **47** and **49** whereby excessive vertical bending moments and side loads resulting for example from angular misalignment between jaw **51** and a pin **36** will be absorbed by transverse bending of web **50** and will not be transmitted via portion **49** and rod **44** to bushings and seals within the cylinder **41.** It is of course to be understood that portion **48** is designed to bend only in response to side loads or bending moments applied thereto, the design thereof being sufficient to sustain the maximum anticipated axial loads to be imposed upon arm **42** without bending or buckling.

A wear plate **55** is rigidly affixed to inward side **62** of portion **49** forwardly adjacent surface **71** and extends longitudinally forwardly therefrom adjacent inward side **62** to terminate rearwardly adjacent a step **56** formed rearwardly adjacent the lip **73.** The inwardly exposed side of plate **55** and adjacent surface **71** form a continuous cam or guiding surface **67** having an anti-

friction surface 69 bonded thereto to minimize friction with pins 36 during engagement therebetween which occurs as described hereinbelow. It is to be noted that plate 55 extends adjacent the inward side 62 of arm portions 47, 48 and 49 but is rigidly affixed only to portion 49 and thus does not interfere with the hereinabove described bending of portion 48.

As noted hereinabove the drive 10 includes control assemblies 50 and 50*a* which are cooperable with selected ones of arms 42 to actuate respective assemblies 40 and 40*a*. Control assembly 50, which it is to be understood is identical to assembly 50*a*, is shown in FIG. 5 as including a flat plate-like base 102 rigidly affixed within housing 20 and carrying thereupon a well known pilot valve 106 and a generally angular control arm assembly 108 pivoted thereto as at 114. Control arm assembly 108 has one end portion 110 thereof pivotally affixed as at 116 to an actuating stem 118 of valve 106 and an opposing end portion 120 engageable with pins 36 and with one of the arms 42 carried by assemblies 40. A biasing force on arm assembly 108 is provided by a suitable helical spring mechanism 122 affixed to base 102 and pivoted to arm portion 110 as at 111 intermediate pivots 114 and 116 to continuously urge the arm 108 in a clockwise direction about pivot 114 (as viewed in FIG. 5) toward a neutral position thereof which is adjustable as by an adjusting screw 124 carried by arm portion 120 and cooperable with adjacent wall portion 24.

Arm portion 120 includes an end portion 126 which is rigidly secured to arm portion 110 adjacent pivot 114 and an elongated cam follower portion 130 which in practice is disposed intermediate the legs of bifurcated cam portion 52 of arm 42 and intermittently engageable by cam roller 53. A cam roller 128 is disposed intermediate arm portions 126 and 130 and spaced inwardly therefrom as by a bracket 134 whereby in practice roller 128 is intermittently engageable by pins 36. The hereinabove mentioned interactions of cooperable pins 36, driving arm 42 and control arm assembly 108 serve to control operation of the drive 10 through actuation of the circuit 60 as follows.

In FIG. 1 the circuit 60 is shown as comprising: a suitable flow source such as a pump 134; fluid flow conduits 138 and 140 which communicate between the pump 134 and respective rear and front portions of cylinder assemblies 41; and a main valve 136 which is cooperable with pilot valve 106 to direct fluid flow from pump 134 to the rear or front portion of cylinders 41 through respective conduits 138 or 140 for advancing and retracting of rods 44. Circuit 60 additionally includes a well known regenerative or feedback conduit 142 communicating between conduit 140 and pump 134 and having a suitable one way check valve 144 therein; a pressure relief valve 146 in communication with conduit 140; and a suitable flow source such as a pump 39 which supplies fluid flow to the pilot valve 106.

It is to be understood that inasmuch as the conduits 138 and 140 communicate with both cylinders 41 of assemblies 40, the assemblies 40 are operable in unison at all times. The cylinders 41 of assemblies 40*a* are likewise operable in unison at all times by an actuating circuit (not shown) which is functionally equivalent to the circuit 60 described hereinabove. It is to be further understood that the pins 36 are so spaced and the control assemblies 50 and 50*a* so positioned with respect thereto that the assemblies 40 and 40*a* alternately engage selected pins 36 of the wheel 30 to provide a sequence of incremental rotations thereof.

As illustrated in FIG. 1 the circuit 60 is supplying fluid flow from pump 134 through valve 136 and conduit 138 to the rearward portion of cylinders 41 for a power stroke whereby the arms 42 are being driven forward to incrementally rotate wheel 30. In the course of such a power stroke the arms 42 and wheel 30 will ultimately reach a position near the end of the power stroke as shown by the solid lines in FIG. 5, at which position the pin 36 is about to disengage the jaw 51 and substantially simultaneously engage cam roller 128 which is disposed adjacent the pin 36 intermediate the legs of arm portion 57 and a pin 36*a* spaced circumferentially clockwise from pin 36 has advanced into the clearance provided by the notch 54 adjacent cam surface 67. At this point the assemblies 40*a* engage selected pins 36 to begin a power stroke thereof. For a short ensuing period all of assemblies 40 and 40*a* are engaging pins 36 and rotating wheel 30 in what is known as an overlap stroke.

As the power stroke of assemblies 40 ends the overlap stroke ends and wheel 30 continues rotating under the impetus of the power stroke of assemblies 40*a*. As wheel 30 continues rotating the pin 36 disengages from jaw 51 and advances to the position indicated at 36′ whereat it is engaging cam roller 128 at 128′, and pin 36*a* concurrently advances to the position indicated at 36*a*′ whereat it is engaging the cam surface 67. It is seen that by engaging cam roller 128′, pin 36′ has displaced arm 108 counterclockwise about pivot 114 to the position 108′ against the biasing force of spring 122 whereby pilot valve 106 has been actuated in response thereto to shift main valve 136 in a well known manner and thus direct fluid flow from pump 134 through conduit 140 to the front of the affected cylinders 41 for the powered retraction of respective arms 42. It will be understood that such powered retraction of the arms 42 is completed in substantially less time than the power stroke of assemblies 40*a* inasmuch as the pump 134 is supplying fluid to a considerably reduced volume including only that portion of the volume of cylinder 41 in front of the piston and not occupied by rod 44.

Under the continuing impetus of the assemblies 40*a* pin 36*a*′ advances to a position 36*a*″ and cams the retracting arm 42 laterally outwardly by engagement with surface 67, and pin 36′ concurrently advances to the position 36″. In response to the outward displacement of arm 42 roller 53 engages the follower portion 130 to cam arm 108 outwardly thereby maintaining circuit 60 in the retract mode of operation.

During the outward displacement of arm 42 the entire assembly 40 is pivoted outwardly about mount body 86, for example from an axis X—X (FIG. 5) to an outwardly displaced axis X′—X′, thereby deforming the mount body 86. The inherent resiliency of body 86 thereupon exerts an inwardly directed restoring force upon the assembly 40 whereby assembly 40 is maintained in forceful engagement with pin 36*a* throughout the retract portion of the cycle. It is of course to be understood that body 86 provides the capability for deflection of assemblies 40 in any plane containing the axis X—X in the manner of a universal pivot.

When arm 42 has been completely retracted to the position 42′ it is retained thereat during the dwell portion of the cycle as pump 134 maintains a nominal pres-

sure in the conduit **140** and dumps excess flow to a suitable reservoir through relief valve **146.** It is to be noted that during dwell the arm at **42'** maintains circuit **60** in the retract mode by means of roller **53'** engaging cam portion **130** of arm **108** as at **130'**.

The continuing power stroke of assemblies **40***a* further advances pin **36***a* to a position (not shown) forwardly adjacent the lip **73** of jaw **51** whereat the inward bias provided by mounting body **86** urges arm **42** inwardly such that pin **36***a* engaged the jaw end portion **57** forwardly of jaw **51** and the cam roller **53** disengages cam follower portion **130** thereby permitting spring **122** to pivot arm **108** in a clockwise direction to the neutral position thereof. In response thereto circuit **60** shifts to the power stroke mode illustrated in FIG. **1.**

During the initial stages of the power stroke mode the arm **42** advances at a relatively rapid rate in an overtake stroke thereof by virtue of the additional fluid supplied to conduit **138** from the front portion of cylinder **41** through conduits **140** and **142,** and valve **144.** Arm **42** thus quickly overtakes and engages the pin **36***a* just prior to the end of the power stroke by assemblies **40***a* whereupon an overlap stroke is begun. Subsequently, assemblies **40** begin a new power stroke as assemblies **40***a* disengage respective pins **36** and are actuated through sequential retract, dwell and overtake strokes as hereinabove described, and a full cycle of operation of drive **10** is thus completed.

By virtue of the structure defined hereinabove a greatly simplified and streamlined drive mechanism is provided. The drive mechanism of the present invention provides a plurality of driving assemblies each supported by an elastomeric mounting affixed adjacent one longitudinal end thereof and captively retained within a socket-like member, and by a support portion disposed adjacent the other longitudinal end thereof and adapted to engage the driven member. Such driving assemblies are thus supported solely from their respective axial extremities with sufficient axial stiffness to withstand maximum anticipated axial loads and in the manner of a universal pivot which permits angular deflection of the driving assembly. The simplified mounting additionally provide an inherent restoring bias to oppose all such angular deflections whereby the driving assembly mounting scheme is operable without recourse to customary universal or pivot joints or spring biasing means.

Furthermore, the driving arms hereof are greatly streamlined by the use of camming means carried only by such arms to control all phases of the operating cycle except the beginning of the retract stroke which is controlled by the ratchet pins. It is to be noted that the drive hereof is operational in response to the relative positions of ratchet pins and driving assemblies; therefore, a retract stroke cannot begin until a pin has been advanced to a predetermined position and a power stroke cannot begin until the driving arm has assumed a predetermined position behind the pin to be engaged.

Finally, it is to be noted that wear on driving cylinder seals and bushings is greatly alleviated by the flexible driving arm portion which bends in response to bending moments and side loads applied thereto.

Inasmuch as the present invention comprises a fluid drive system having a plurality of driving assemblies affixed by elastomeric mountings to a housing member and including pusher arms therefor adapted to engage a driven member and further adapted to control the operational cycle thereof, various modifications thereto are possible without departing from the broad spirit and scope thereof. For example mounting body **86** may take any of numerous forms consistent with the requirements of axial shock absorbing capacity and lateral motion such as a frustrum of a pyramid or a rectangular solid, camming means carried by arms **42** could take various forms, flexible arm portion **48** could be of a cylindrical or other suitable cross section to allow for bending in various planes and the like.

These and other modifications having been envisioned and anticipated it is requested that this invention be interpreted broadly and limited only by the scope of the claims appended hereto.

What is claimed is:

1. A hydraulic driving system for imparting a rotary motion to a rotary load comprising: a body member; a driving ring adapted to be drivingly connected to such a rotary load; said driving ring including a plurality of circumferentially spaced driving portions thereon; a plurality of elongated intermittently acting hydraulically actuated piston assemblies carried by said body member and each having reciprocable extensible portions which are drivingly engageable with selective ones of said driving portions throughout at least a portion of the extension thereof; valve means adapted to communicate with a hydraulic fluid pressure source and operative to control the flow of fluid from such a source to said piston assemblies to provide sequential extension and retraction of said extensible portions; and at least one of said piston assemblies including camming means thereon which are cooperable with selective ones of said driving portions to control the operation of said valve means.

2. A hydraulic driving system as specified in claim **1** wherein said camming means are carried solely by said extensible portion.

3. A hydraulic driving system as specified in claim **1** wherein each of said piston assemblies is pivotally mounted to said body member adjacent one end thereof opposite said extensible portions and said extensible portions extend generally tangentially with respect to the periphery of said driving ring.

4. A hydraulic driving system as specified in claim **3** wherein during at least a major portion of the retraction stroke of said extensible portion of said at least one of said piston assemblies said selective ones of said driving portions engages a portion of said camming means on the inner longitudinal side of said extensible portion to cause said at least one of said piston assemblies to pivot outwardly from the periphery of said driving ring about said one end thereof.

5. A hydraulic driving system as specified in claim **4** wherein during at least a major portion of the retraction of said extensible portion of said at least one of said piston assemblies a portion of said camming means on the other longitudinal side of said extensible portion engages said valve means to cause said valve means to maintain pressure fluid flowing to the retract side of said piston assemblies.

6. A hydraulic driving system as specified in claim **1** wherein at the end of the extension stroke of said extensible portion of said at least one of said piston assemblies, the driving portion being driven by said extensible portion operatively engages said valve means

to cause said valve means to channel pressure fluid to the retract side of said piston assemblies and initiate a retraction stroke of said extensible portion.

7. A hydraulic driving system as specified in claim **3** wherein said piston assemblies are pivotally connected to said body member by respective pivot assemblies each comprising: an elastomeric member rigidly secured to said one end; a cup-shaped retaining member rigidly secured to said body member and said elastomeric member; and the inner periphery of said retaining member conforms to the outer periphery of said elastomeric member in a manner that at least the major portion of said outer periphery engages said inner periphery when said elastomeric member is rigidly secured to said body member.

8. A method of operating a piston assembly which has a reciprocable extensible portion thereof selectively drivingly engaging circumferentially spaced engageable portions of a driving ring which is drivingly connected to a rotary load to apply a rotary motion thereto comprising the steps of: extending said extensible portion by supplying a hydraulic pressure fluid to the extension side of said piston assembly; simultaneously with said extending, drivingly engaging a selective one of said engageable portions with the free end of said extensible portion throughout at least the major portion of said extending; at the termination of said extending, said extensible portion engaging a valve means in cooperation with said selective one of said engageable portions to cause the supply of hydraulic pressure fluid to be supplied to the retraction side of said piston assembly to retract said extensible portion.

9. A method of operating a piston assembly as specified in claim **8** including the additional step of: retracting said extensible portion from the extended position thereof by supplying hydraulic pressure fluid to the retraction side of said piston assembly.

10. A method of operating a piston assembly as specified in claim **9** including the additional step of: simultaneously with said retracting engaging said valve means with said extensible portion to maintain the flow of hydraulic fluid to said retract side throughout said retracting.

11. A method of operating a piston assembly as specified in claim **10** wherein said last mentioned engaging is maintained by biasing said extensible portion outwardly with respect to the periphery of said driving ring.

* * * * *