

Nov. 1, 1966

A. A. BAUERS
METERING PUMP

3,282,218

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3 Sheets-Sheet 2

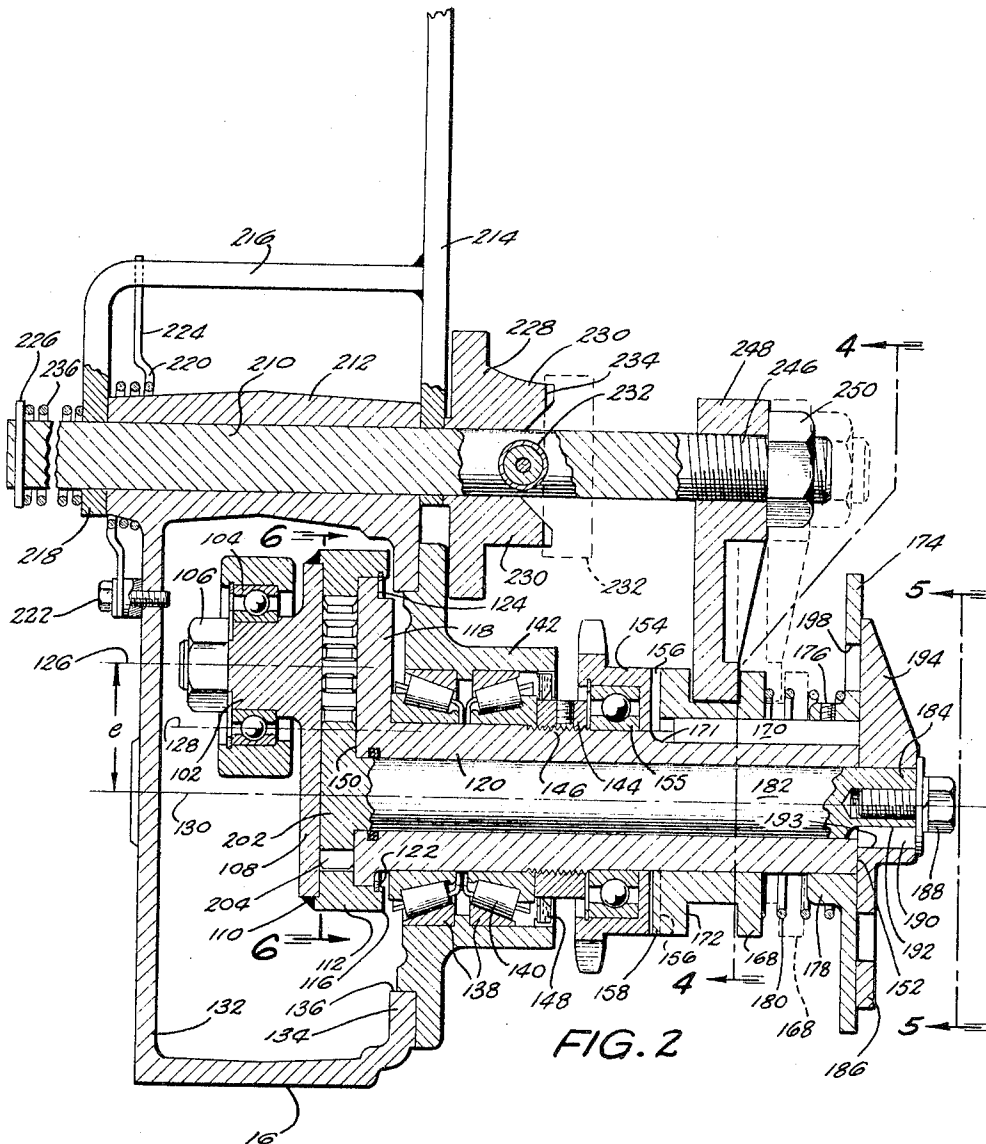


FIG. 2

INVENTOR.
ARTHUR A. BAUERS
BY
Olsen and Stephenson
ATTORNEYS

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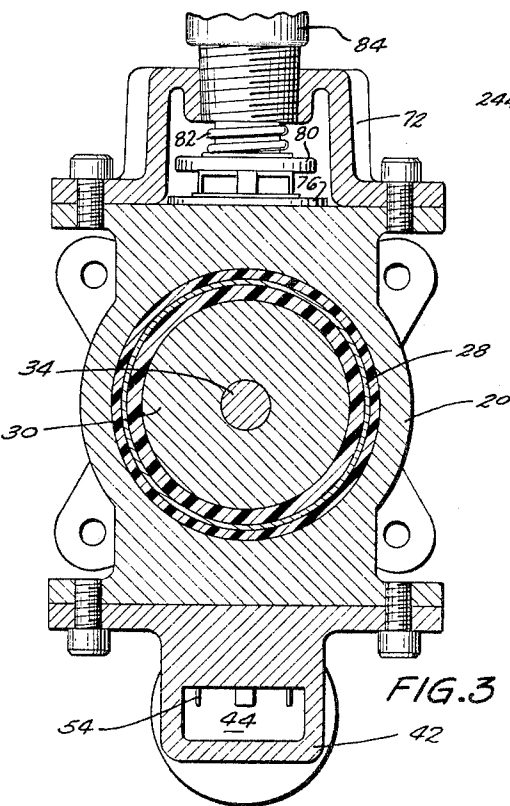


FIG. 3

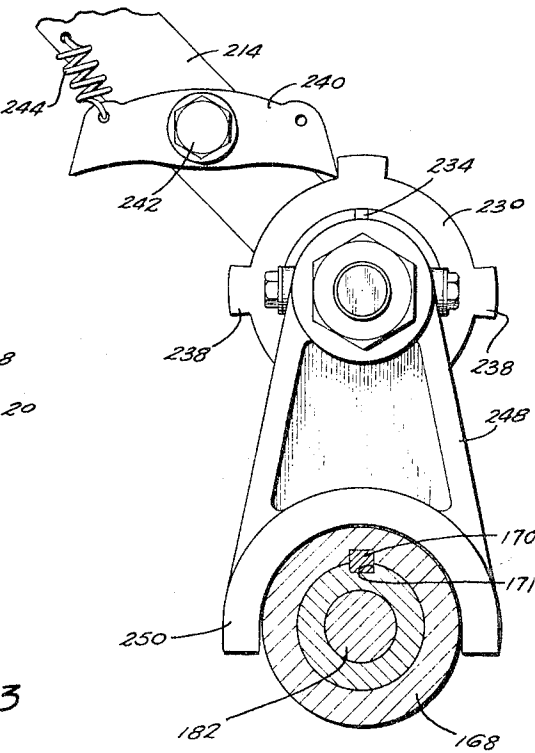


FIG. 4

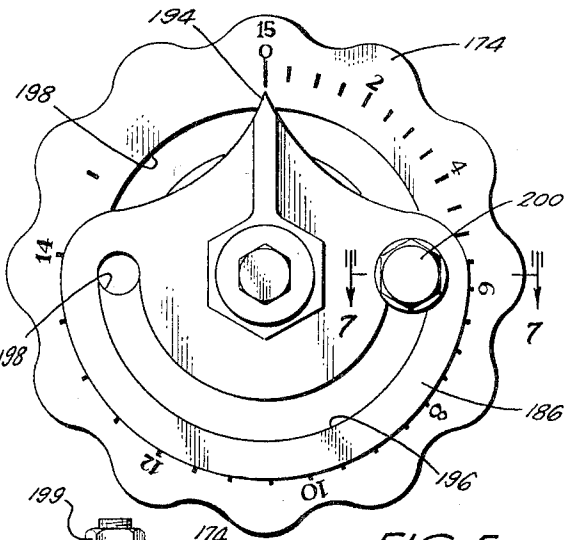


FIG. 5

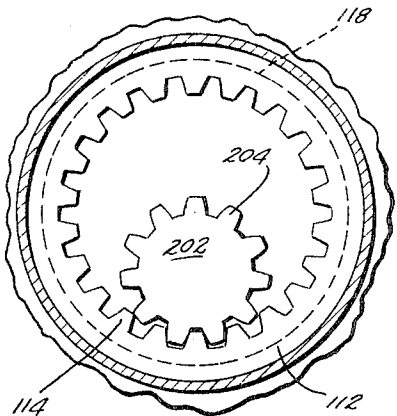


FIG. 6

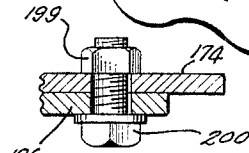


FIG. 7

INVENTOR.
ARTHUR A. BAUERS

BY

Olsen and Stephenson
ATTORNEYS

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METERING PUMP

Arthur A. Bauers, Beatrice, Nebr., assignor to Hoover Ball and Bearing Company, Saline, Mich., a corporation of Michigan

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5 Claims. (Cl. 103-38)

This invention relates generally to pumps and more particularly to an improved liquid metering pump of reciprocal piston type having a piston stroke adjusting mechanism which is operable from outside the pump housing.

Pumps of the type to which this invention relates are particularly useful in connection with liquid fertilizer applicators for pumping accurately metered amounts of fertilizer to the discharge nozzles which direct the fertilizer to the soil. This type of pump is driven from the applicator ground wheels so that the amount of fertilizer applied to each acre of the soil will not vary with the speed of travel of the applicator. In such pumps, long service life and low maintenance costs are desirable, and an accurate setting of the pump over a wide range of flow adjustments is particularly desirable. It is also desirable to provide a pump drive mechanism which will not limit the road speed of the applicator during travel to and from fields being fertilized.

It is an object of this invention, therefore, to provide an improved liquid metering pump which incorporates structure that accomplishes the above desirable objectives, has all of the moving parts associated with the drive shaft mounted on anti-friction bearings to increase the useful service life of the pump and reduce maintenance cost, has a dial pointer which is movable through at least a complete 360° circle from zero to full stroke of the pump to enable a fine setting of the pump flow adjustment to insure the application of a predetermined amount of fertilizer per acre without trial and error settings, and has the pump drive sprocket mounted on anti-friction bearings so that it can rotate at high speed and thereby avoid limiting the road speed of the applicator.

A further object of this invention is to provide a pump having the above-described advantages which is economical to manufacture because of the reduced number of parts in the pump and which is easy to assemble and operate.

Further objects, features and advantages of this invention will become apparent from a consideration of the following description, the appended claims, and the accompanying drawing in which:

FIGURE 1 is a longitudinal sectional view of the pump of this invention;

FIGURE 2 is an enlarged transverse sectional view of a portion of the pump of this invention looking substantially along the line 2-2 in FIG. 1;

FIGURE 3 is an enlarged fragmentary transverse sectional view of another portion of the pump of this invention as seen from substantially the line 3-3 in FIG. 1;

FIGURE 4 is a fragmentary transverse sectional view looking substantially along the line 4-4 in FIG. 2;

FIGURE 5 is an elevational view of the relatively movable pump stroke adjusting plates in the pump of this invention, as seen from the line 5-5 in FIG. 2;

FIGURE 6 is a fragmentary sectional view of a portion of the stroke adjusting mechanism in the pump of this invention looking substantially along the line 6-6 in FIG. 2; and

FIGURE 7 is a fragmentary detail sectional view of a portion of the pump of this invention looking substantially along the line 7-7 in FIG. 5.

With reference to the drawing, the pump of this invention, indicated generally at 10, is illustrated in FIG. 1 as including a two-section housing 12, one section 14 constituting an enclosure for the pump piston, and another section 16 constituting a crankcase. The housing section or crankcase 16 is provided with attaching feet 18 which, when the pump 10 is utilized as a metering pump for liquid fertilizer, are secured to the applicator frame by bolts or the like (not shown).

Forming a part of the housing section 14 is an irregularly-shaped cylinder 20 having an end wall 22 and an opposite end wall 24 in which a removable cylinder cap 26 is supported. A tubular cylinder liner 28 is supported in the cylinder 20 and a piston 30 is slidably mounted in the cylinder liner 28. Seal rings 32 carried by the piston 30, maintain the piston in a fluid-tight engagement with the inner wall of the cylinder liner 28 to prevent fluid communication of opposite sides of the piston 30. A similar annular seal 33 is provided around the liner 28 to prevent liquid flow between the liner 28 and the cylinder 20. A piston rod 34 is secured at one of its ends by a nut 36 to the piston 30. The piston rod 34 extends in a direction away from the cylinder 20 through an opening 38 in the cylinder end wall 22, which also constitutes an end wall of crankcase 16, and through a packing gland 40 which is formed integral with the end wall 22 into the crankcase 16.

An inlet valve cover 42, secured to the bottom side of the cylinder 20 includes a chamber 44, which functions as a fluid inlet chamber for pump 10, and an inlet connection 46 which is connected to a supply tank (not shown) for a liquid, such as fertilizer, to be metered by the pump 10. A pair of tubular valve seats 48 are mounted in the inlet valve cover 42 so that they communicate at their inlet ends with the chamber 44. A pair of inlet valve members 50 and 52 are secured to spider-shaped valve guides 54 which are slidably supported in the valve seats 48 so that the valve members are movable up and down, in the illustrated embodiment of the invention, between open and closed positions. A screw 56 secures the valve guide member 54 to the valve member 50 and also attaches a spring guide 58 to the valve member 50. The spring guide 58 is aligned with a projection 60 on the cylinder 20, and a compression spring 62 is mounted on the guide 58 and the projection 60 so that it extends between the cylinder 20 and the valve member 50 and urges the valve member 50 toward a closed position in which it is engaged with its seat 48. A similar screw 64, used to attach a valve guide 54 to the valve member 52, mounts a spring guide 66 on the valve member 52 in a position aligned with a projection 68 on the cylinder 20. A spring 70, positioned about the guide 66 and the projection 68, urges the valve member 52 toward its seated position shown in FIG. 1.

A discharge valve cover 72 is mounted on the top side of the cylinder 20 in the illustrated embodiment of the invention so as to form an enclosed discharge chamber 74 which communicates with the cylinder 20 through a pair of valve seats 76 mounted on the cylinder 20. Discharge valve members 78 and 80 are guidably mounted for movement between open and closed positions relative to the seats 76 in a manner similar to the mounting of the inlet valves 50 and 52, and are urged toward seated positions by springs 82. A discharge manifold 84 is mounted on the discharge valve cover 72 so that it communicates with the discharge chamber 74. Discharge openings 86 in the manifold 84 are connected, such as by flexible tubes (not shown), to liquid discharge nozzles (not shown) which are disposed adjacent the soil, when the pump 10 is used to pump liquid fertilizer, so that the nozzles direct the fertilizer into the soil.

It can thus be seen that when the piston 30 is moving in the direction of the arrow A, as illustrated in FIG. 1, suction will be obtained on the side 88 of the piston 30 so as to open the valve member 50 against the pressure of the spring 62, and draw fluid from the inlet chamber 44 into the cylinder liner 28 on the side 88 of the piston 30. This suction will also enable one of the springs 82 to maintain the valve 78 in a closed position. The positive pressure on the opposite side 90 of the piston 30 will close the inlet valve 52 and open the discharge valve 80 so that liquid in cylinder 20 will be pumped by the piston 30 into the outlet chamber 74 for discharge through the manifold 84. The valves 50, 52, 78 and 80 are illustrated in the positions in which they are placed by movement of the piston 30 in the direction of the arrow A. On return of the piston 30, so that it is moving in a direction opposite to the direction of arrow A, inlet valve 50 and discharge valve 80 are closed and inlet valve 52 and discharge valve 78 are opened. As a result, the fluid which was drawn into the cylinder liner 28 through the open valve 50, during movement of the piston 30 in the direction of the arrow A, is discharged through the discharge valve 78 to the manifold 84 on return travel of the piston 30.

It can thus be seen that reciprocal movement of the piston 30 is utilized to discharge fluid from the inlet chamber 44 through the manifold 84, and the amount of fluid discharged during each cycle of the piston 30 is dependent on the length of stroke of the reciprocally movable piston 30.

The piston rod 34 extends from the packing gland 40 through an annular wiper seal 91 in the crankcase 16 and is attached at its opposite end to a crosshead 92 slidably supported in a tubular guide 94 mounted in the crankcase 16 which is partially filled with lubricating fluid. One end of a connecting link 96 is pivotally connected, by a pin 98, to the crosshead 92 which thus functions to pivotally connect the connecting rod 96 to the piston rod 34. The opposite end 100 of the connecting rod 96 is of annular shape and is moved, during operation of the pump 10, through a circular path, the diameter of which determines the length of stroke of piston 30. The connecting rod end 100 is mounted on a ball bearing unit 104 (FIGS. 1 and 2) supported on a stub shaft 102 and maintained thereon by a nut 106.

The stub shaft 102 is formed integral with a circular plate 108 which is secured, as by welding 110, to a ring gear 112 provided with internal teeth 114 (FIGS. 2 and 6). The ring gear 112 is provided with an axial flange 116 which is rotatably supported on a circular eccentric 118 formed on the inner end of a sleeve 120. A retainer ring 122 carried by the flange 116 is engaged with a shoulder 124 on the eccentric 118 so as to retain the ring gear 112 in a supported position on the eccentric 118.

As best appears in FIG. 2, the axis 126 of the stub shaft 102 is eccentric with respect to the axis 128 of the eccentric 118. As a result, on rotation of the ring gear 112 about the eccentric 118, the spacing or eccentricity of the stub shaft axis 126 with respect to the axis 130 of the sleeve 120, indicated at "e" in FIG. 2, is adjustable between the maximum illustrated in FIG. 2 and the minimum in which the axes 126 and 130 coincide. The distance "e" determines the diameter of the circular path of travel of connecting rod end 100 and thus determines the stroke of the piston 30, so as to control the volume of liquid discharged through the manifold 84 on each cycle of the piston 30.

The crankcase 16 has a pair of side walls 132 and 134 and the sleeve 120 projects into the crankcase 16 through an opening 136 in the side wall 134. A pair of side-by-side anti-friction bearing units 138, each of which includes tapered roller bearings 140, are carried by a mounting body 142 which is secured to the crankcase end wall 134 so as to position the bearing units 138 in positions in which they rotatably support the sleeve 120. A retainer

nut 144, threaded onto a threaded section 146 of the sleeve 120, engages the outer one of the bearing units 138. A seal 148 extends between the body 142 and the nut 144.

The sleeve 120 is of a length such that with its inner end 150 positioned in the crankcase 16 it extends a substantial distance out of the crankcase so that the outer end 152 of the sleeve 120 is positioned a substantial distance away from the crankcase 16. Intermediate its outer end 152, and the nut 144, the sleeve 120 has a drive sprocket 154 rotatably mounted thereon by means of a ball bearing unit 155. The drive sprocket 154 is connected by a drive chain (not shown) to the applicator ground wheels, when the pump 10 is used for metering liquid fertilizer, so that the drive sprocket 154 is driven in response to ground travel of the applicator at a speed dependent on the speed of travel of the applicator. The drive sprocket 154 is formed on its outer side with a plurality of teeth 156 which can mesh with corresponding teeth 158 formed on the adjacent side of a clutch collar 160 that is slidably mounted on a key 170 (FIGS. 2 and 4). The key 170 is mounted in a keyway 171 formed in the periphery of the sleeve 120 adjacent its outer end 152. The clutch collar 168 is formed with an annular groove 172 for a purpose to appear presently.

A dial plate 174, of annular shape, is fixed to the outer end 152 of the sleeve 120 by means of the key 170 and a set screw 176 which is extended through a flange 178 on the plate 174 into engagement with the key 170. As shown in FIG. 5, the outer edge of the dial plate 174 is knurled to facilitate manual gripping of the dial plate 174 and dial numbers, from "0" to "15" are imprinted on the outer side of the dial plate 174 and arranged in a circular formation. A spring 180 extends between the dial plate 174 and the outer side of the clutch collar 168 so as to urge the clutch collar 168 toward the drive sprocket 154 to a position in which the teeth 158 are engaged with the teeth 156. The clutch collar 168 is slidable on the sleeve 120 and the key 170 in a direction away from the drive sprocket 154 to the broken line position shown in FIG. 2 to disengage the teeth 156 and 158.

A drive shaft 182 is rotatably supported in the sleeve 120 in a coaxial relation with the sleeve 120 so that sleeve axis 130 also constitutes the drive shaft axis. The outer end 184 of the drive shaft 182 extends outwardly beyond the outer end of the sleeve 120 and has an annular dial pointer plate 186 fixedly mounted thereon by means of a screw 188, which is threaded into the outer end of the drive shaft 182, and a key 190 positioned in a keyway 192 in the shaft 182 and extended through a notch 193 in plate 186. The dial pointer plate 186 is of an irregular shape, as shown in FIG. 5, and includes a pointer 194. An arcuate slot 196, of an angular length exceeding 180°, is formed in the dial pointer plate 186 and a similar slot 198 is formed in the dial plate 174 (FIGS. 2 and 5). A bolt 200 is inserted through the slots 196 and 198 so that when a nut 199 on bolt 200 is tightened, the plates 174 and 186 are connected and secured against relative rotation. To relatively rotate the plates 174 and 186, the nut 199 is loosened, following which the plates 174 and 186 are relatively rotated, and then the nut 199 is re-tightened. With the bolt 200 positioned as shown in FIG. 5, which illustrates the pump in a full stroke condition, during movement of pointer plate 186 in a counter-clockwise direction relative to dial plate 174, the bolt 200 remains in the illustrated position for the first 180° of movement. During the next 180° of movement, bolt 200 slides in slot 198. A similar situation prevails during clockwise movement of dial plate 186 toward full stroke condition.

A pinion gear 202 is formed integral with the inner end of the drive shaft 182 and is provided with external teeth 204 which mesh with the teeth 114 on the ring gear 112. To adjust the stroke of the piston 30, the bolt 200 is loosened, the dial plate 174 is manually held, and the

pointer plate 186 is manually rotated relative to the plate 174. Such rotation is facilitated by the formation of the pointer 194 as a radially extending flange on the outer face of the plate 186. The pinion gear 202 is formed with a predetermined number of teeth, eleven in the illustrated embodiment of the invention, which number is preferably half the number of teeth 114 on the ring gear 112, which in the illustrated embodiment of the invention is provided with twenty-two teeth, for the purpose of providing fine adjustment of the stroke of piston 30. As a result of this arrangement, a full 360° rotation of the pinion gear 202 is required to move the stub shaft 126 between a zero stroke position, in which the axes 126 and 130 coincide, and a full stroke position in which the axis 126 is spaced the maximum distance from the axis 130. In the illustrated embodiment of the invention, the number of teeth 204 is equal to one half the number of teeth 114, so that the maximum stroke position of the stub shaft 102 is obtained by rotating pointer plate 186 a full 360° from the position plate 186 is in when stub shaft 126 is in zero stroke position. In the event the number of teeth 204 is less than half the number of teeth 114, a maximum stroke position of the shaft 102 is obtained by rotating the dial pointer 194 more than 360°. In the use of the pump 10 to meter liquid fertilizer, a chart is associated with the dial plate 174 so as to relate dial settings to volume of fertilizer pumped per acre of ground.

To enable an operator to move the clutch collar 168 toward and away from the drive sprocket 154 from a location remote from the pump 10, a shaft 210 is journaled in a boss 212 formed on the crankcase (FIGS. 1 and 2). A clutch actuating lever 214 is rotatably mounted on the shaft 210 at a position adjacent the crankcase side wall 134. An angle-shaped bracket 216, secured at one end to one side of the lever 214, has its opposite end 218 rotatably mounted on the shaft 210 adjacent the opposite side wall 132 of the crankcase 16. A torsion spring 220 wound about the boss 212 is secured at one end by a screw 222 to the crankcase side wall 132. The opposite end 224 of the torsion spring 220 is engaged with the bracket 216 so as to urge the lever 214 in a counter-clockwise direction as viewed in FIG. 4.

A cam 228, having a pair of diametrically opposite side lobes 230, is rotatably supported on the shaft 210 adjacent the lever 214. A cylindrical cam follower 232, secured to the shaft 210 so that it extends diametrically thereof, is engageable with the cam 228 at a position between the lobes 230, as shown in solid lines in FIG. 2, and when the cam 228 is rotated 90° from its position shown in FIG. 2, the follower 232 is positioned in grooves 234 formed at the outer ends of the lobes 230, so that the follower 232 will be positioned with respect to the cam 228 as shown in broken lines in FIG. 2, although it is to be understood that the follower 232 is never rotated, but only moved axially of shaft 210, in response to rotation of cam 228. Rotation of cam 228 moves follower 232 axially with respect to cam 228, and follower 232 is shown in broken lines in FIG. 2 only to illustrate that it and cam 228 are movable to positions in which the follower rests in cam grooves 234 to thereby move follower 232 in a direction axially of shaft 210. A compression spring 236 extends between bracket 216 and a stop 226 on shaft 210 so as to urge the follower 232 against the cam 228.

At its periphery, the cam 228 is formed with four teeth 238 (FIG. 4) disposed 90° apart on the circumference of the cam 228. A dog 240, pivotally mounted on the lever 214 by means of a bolt 242 is positioned in the plane of the cam teeth 238 and is urged toward the cam teeth 238 by a spring 244 which extends between the lever 214 and the dog 240 as shown in FIG. 4.

The shaft 210 has a threaded end portion 246 on which an arm 248 is mounted and is retained thereon by a nut 250. The arm 248 is of irregular shape, as shown in

FIG. 4, and has an arcuate, substantially semi-circular lower end portion 250 which is disposed in the groove 172 in the clutch collar 168.

It can thus be seen that when the lever 214 is moved in a clockwise direction from its position shown in FIG. 4, through an angle of substantially 90°, the cam 228 is rotated 90° by the action of the dog 240 on the cam tooth 238. When the lever 214 is returned to its original position, by the torsion spring 220, the dog 240 will ride up over the next tooth 238 and be returned to engagement with the periphery of cam 230 by spring 244, so that the lever 214 will be positioned for engagement with that next tooth 238 when the lever is next moved in a clockwise direction. Assume that the cam follower 232 is in the position shown in solid lines in FIG. 2 in which the teeth 156 and 158 on the sprocket 154 and the collar 168 are in driving engagement, so that the pump 10 is being operated in response to rotation of the drive sprocket 154. The cam follower 232 is then in the position shown in solid lines in FIG. 2. When the lever 214 is rotated clockwise through an angle of 90° from its FIG. 4 position, the follower 232 is forced to ride up the cam lobes 230 to a position in the cam grooves 234. This movement of the follower 232 causes the shaft 210 to move to the right, as viewed in FIG. 2 to also move the clutch collar operating arm 250 to the right, thereby moving the clutch collar 168 to its broken line position shown in FIG. 2 to disengage the teeth 156 and 158. With the clutch collar 168 in its broken line position, the drive sprocket 154 rotates on the bearing unit 155 without operating the pump 10.

In the use of the pump 10 on a fertilizer applicator, the lever 214 is conveniently operated by means of a pull rope from the towing tractor for the fertilizer applicator. When it is desired to transport the applicator between fields, or for any reason discontinue operation of the pump 10, the lever 214 is manipulated to disengage the clutch teeth 158 from the drive sprocket teeth 154. Following such disengagement, ground travel of the applicator merely results in rotation of the drive sprocket 154 without causing operation of the pump 10. Because the sprocket 154 is mounted on a ball bearing unit 155, the applicator may be transported at any desirable ground speed without danger of wearing out any of the pump components. When operation of the pump 10 is next desired, the lever 214 is again rotated in a clockwise direction, as viewed in FIG. 4, to rotate the cam 228 to a position in which the cam portion between the lobes 230 is aligned with the follower 232. The pressure of the spring 236 on the follower 232 will then move the follower 232 to a position between the lobes 230, with a resulting movement of the shaft 210 to the left as viewed in FIG. 2. The spring 180 also urges the shaft 210 in this direction so that the springs 180 and 236 cooperate to move the clutch teeth 158 into engagement with the drive sprocket teeth 156. As soon as the teeth 156 and 158 are engaged, the drive sleeve 120 and the drive shaft 182 are rotated as a unit, along with the stub shaft 126 which is connected to the drive shaft 182 through the engaged teeth 114 and 204.

When adjustment of the output of the pump 10 is desired, operation of the pump is disconnected, by disengaging the teeth 158 and 156, the screw 200 is loosened, the plates 174 and 186 are rotated relative to each other to in turn move the stub shaft axis 126 toward or away from the drive shaft axis 130, depending on whether decreased or increased output, respectively, of the pump is desired, following which the screw 200 is utilized to reconnect the plates 174 and 186. As soon as the clutch collar 168 is moved to re-engage the teeth 156 and 158, the pump 10 is operable at the changed output.

From the above description it is seen that this invention provides a pump 10 in which the stroke of the piston 30 is operable from outside the pump housing 12 by relative rotation of the plates 174 and 186. By virtue of pro-

vision of the pinion gear 202 and the ring gear 112, each increment of movement of the dial pointer plate 186 relative to the dial plate 174 provides for a small adjustment of the stroke of the piston 30. As a result, accurate adjustments in fine increments of the pump stroke are obtained with the pump of this invention. By virtue of the mounting of the movable parts of the pump adjusting mechanism on the anti-friction bearing units 133, the pump 10 is usable over a prolonged service life with a minimum of maintenance. Should removal of the stroke adjustment mechanism from the crankcase 16 be required, such structure is readily removable through the crankcase side wall opening 136 by removing the bearing supporting body 142. This ease of disassembly is provided by the arrangement of the pump structure so that the sleeve 120 and the drive shaft 182 extend through only one side wall of the crankcase 16. Such structure also provides the desired pump results with a minimum number of parts.

It will be understood that the metering pump which is herein disclosed and described is presented for purposes of explanation and illustration and is not intended to indicate limits of the invention, the scope of which is defined by the following claims.

What is claimed is:

1. In a pump mechanism, a crankcase having side and end walls, a drive sleeve extended through one of said side walls and having an inner end positioned in said crankcase and an outer end disposed outside said crankcase, a reciprocal element extended through one of said end walls for reciprocation along a path normal to said sleeve, anti-friction bearings mounted on said one side wall and constituting the sole support for said sleeve so that said sleeve is rotatable in said bearings about the sleeve axis, a connecting link having a pair of ends, means rotatably mounting one end of said connecting link in said crankcase, said connecting link being pivotally connected at its opposite end to said reciprocal element for reciprocating said element in response to movement of said one end of the connecting link in a circular path about said sleeve axis, shaft means extending substantially axially through said sleeve, coaxing means on said shaft means and said sleeve disposed in said crankcase and operable upon relative rotation of said sleeve and shaft means to adjust the diameter of said circular path, means outside said crankcase secured to said shaft means for adjustably connecting said shaft means and said sleeve in different relatively rotated positions, a drive sprocket, anti-friction bearing means rotatably supporting said sprocket on said sleeve, a clutch collar slidably mounted on said sleeve for axial movement relative thereto toward and away from said sprocket, said collar being secured to said sleeve so that rotation of said collar causes rotation of said sleeve, and engageable tooth means on said sprocket and said collar providing for driving of said collar by said sprocket in one position of said collar.

2. In a pump mechanism according to claim 1 in which said clutch collar is provided with a peripheral groove, means operable to slide said clutch collar toward and away from said sprocket comprising an actuating shaft slidably mounted on said crankcase for reciprocal movement in a direction substantially parallel to said sleeve axis, cam means rotatably mounted on said actuating shaft, a cam follower secured to and extending diametrically of said actuating shaft, spring means urging said follower into engagement with said cam, lever means rotatably mounted on said shaft, a torsion spring, mounted on said crankcase and urging said lever means in one direction, means on said lever means operable to rotate said cam means on movement of said lever means in the opposite direction, said cam means being operable on rotation to move said follower so as to reciprocate said shaft,

and arm means carried by said shaft and extending into said clutch collar groove so as to slide said clutch collar toward and away from said drive sprocket in response to reciprocal movement of said shaft.

3. In an adjustable stroke pump having a reciprocable piston, a crankcase having side walls, rod means connected to said piston for reciprocating the piston and extending into said crankcase between said side walls, a drive shaft having an axis substantially perpendicular to said side walls and said rod means, a motion transmitting shaft disposed in said crankcase and having an axis substantially parallel to said drive shaft axis, said motion transmitting shaft being connected to said rod means so that it is operable to transmit rotation of said drive shaft to reciprocal movement of said piston, and in which the axial spacing between said shaft axes determines the magnitude of the reciprocal movement of said piston and thus the stroke of said pump; means for adjusting said spacing comprising a pinion gear in said crankcase secured to one end of said drive shaft and provided with external teeth, a ring gear in said crankcase having internal teeth arranged in meshing engagement with said pinion gear teeth, means mounting said motion transmitting shaft on said ring gear at a position spaced axially outwardly from said one end of said drive shaft and in an eccentric relation with said ring gear, a sleeve extended through and rotatably supported on only one of said crankcase side walls and arranged in a coaxial supporting relation with said drive shaft, single bearing means in said one crankcase side wall rotatably supporting said sleeve, eccentric means on one end of said sleeve positioned in said crankcase adjacent said pinion gear and rotatably supporting said ring gear so that it is eccentric with respect to said pinion gear whereby on relative rotation of said drive shaft and said sleeve said motion transmitting shaft axis is moved toward or away from said drive shaft axis to thereby adjust the spacing between said axes and thus the stroke of said pump, and means secured to said drive shaft and said sleeve outside said crankcase operable manually to effect relative rotation of said drive shaft and said sleeve.

4. The structure according to claim 3 further including means for adjustably connecting said drive shaft and said sleeve in different relatively rotated positions thereof, a drive sprocket, anti-friction bearing means rotatably supporting said sprocket on said sleeve, clutch means secured to and slidably mounted on said sleeve for axial movement relative thereto toward and away from said sprocket, and engageable means on said sprocket and said clutch means providing for driving of said clutch means by said sprocket in one position of said clutch means.

5. The structure according to claim 3 in which said means for effecting relative rotation of said drive shaft and said sleeve includes a dial plate secured to said sleeve at a position outside said crankcase, and a dial indicator member secured to said drive shaft in a position adjacent said dial plate.

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LAURENCE V. EFNER, *Primary Examiner*.