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Grizzle

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(54) **APPARATUS FOR ADDING FERTILIZER TO WATER IN A SPRINKLER SYSTEM**

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B05B 7/30 (2006.01)
A01C 23/04 (2006.01)

(52) **U.S. Cl.**
CPC ***A01C 23/042*** (2013.01); ***B05B 7/30*** (2013.01)

(58) **Field of Classification Search**
CPC F16K 15/02; F16K 15/021; F16K 15/06; A01C 23/042; B05B 7/30
USPC 239/463
See application file for complete search history.

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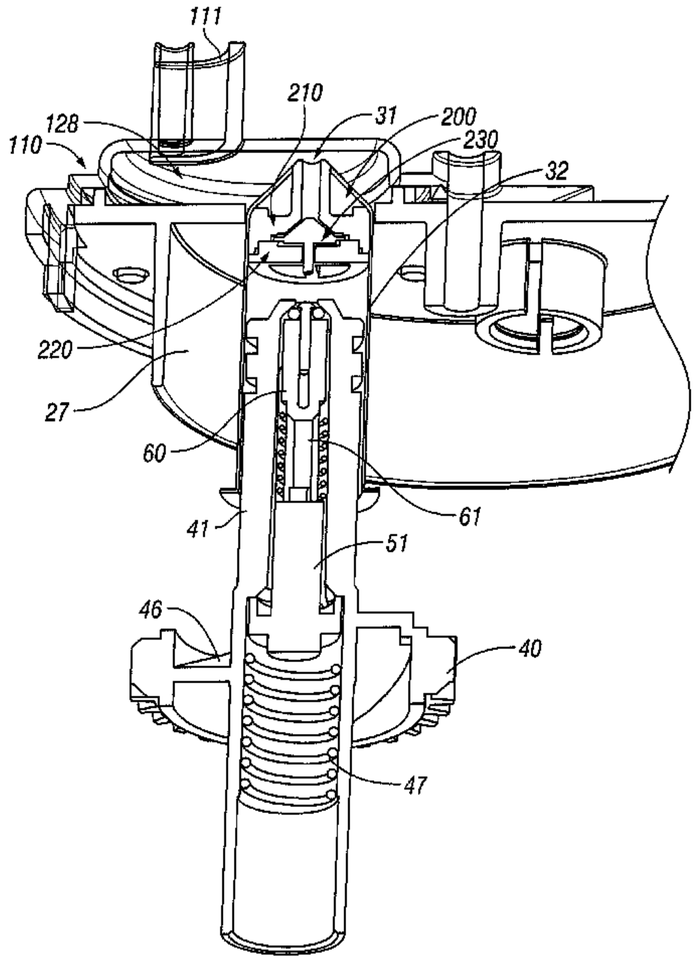
(57) **ABSTRACT**

An apparatus for injecting liquid fertilizer into a water flow line in a sprinkler system, includes an injector mechanism body having a water inlet and a water outlet adapted to be connected in the water flow line of the sprinkler system so that water flows through at least a portion of the injector mechanism body, a plunger chamber, a plunger movably positioned in the plunger chamber, a paddle wheel positioned to be rotated by water flowing through the injector mechanism body, a plunger gear coupled to the paddle wheel and the plunger so as to rotate when the paddle wheel rotates so as to move the plunger back and forth within the plunger chamber and a valve assembly secured at a fixed location in the plunger chamber.

3 Claims, 6 Drawing Sheets



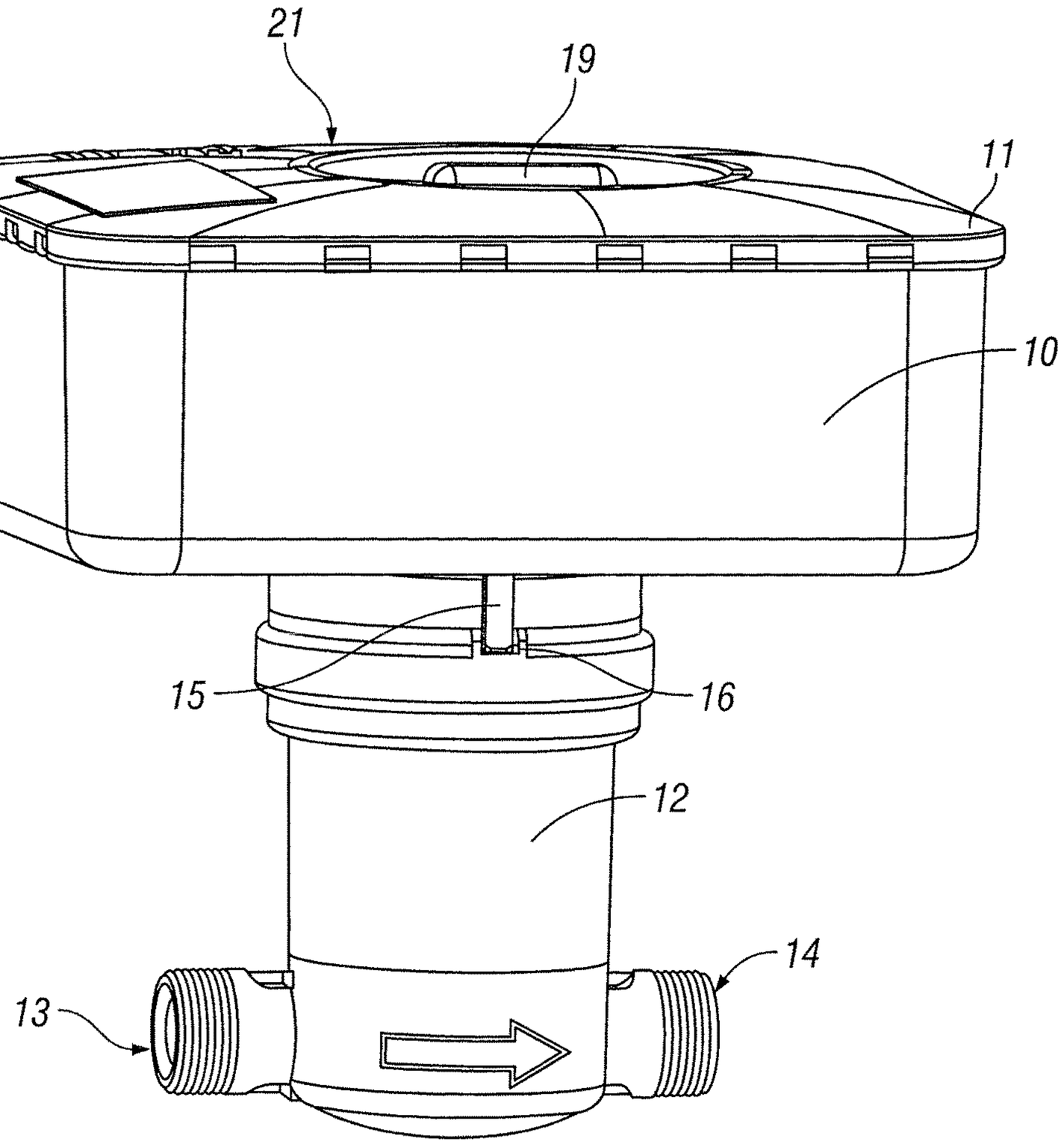


FIG. 1
(Prior Art)

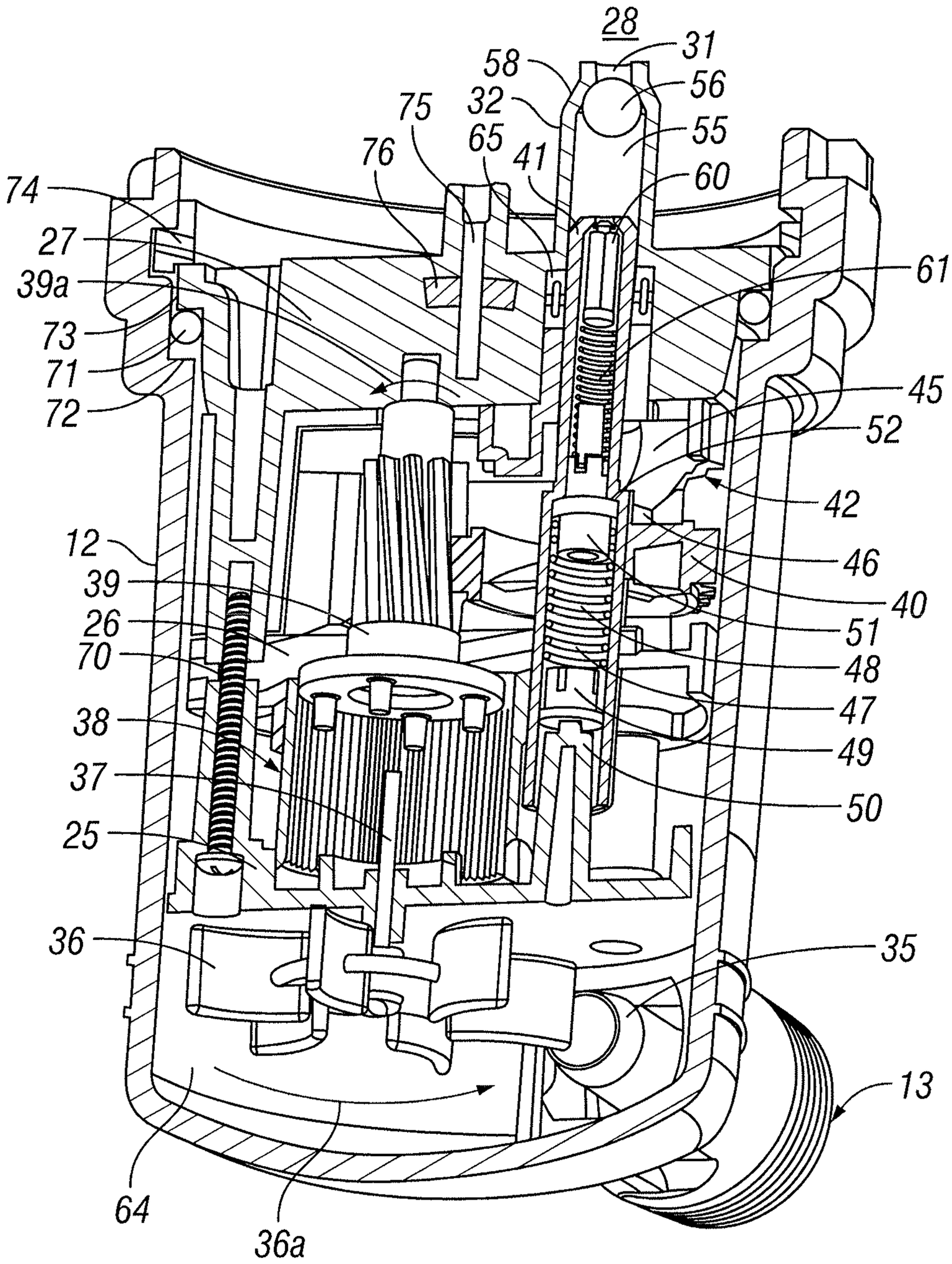


FIG. 2
(Prior Art)

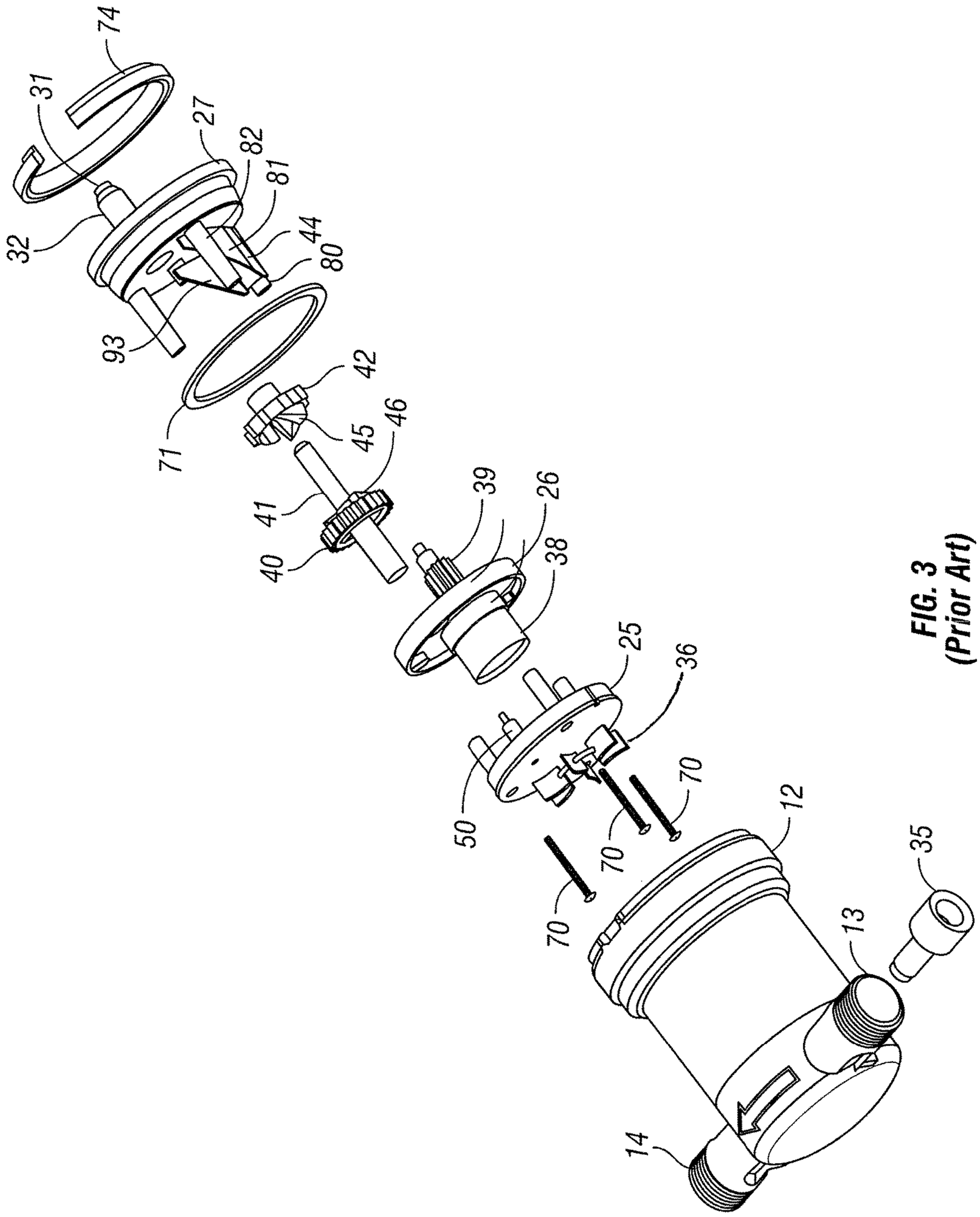


FIG. 3
(Prior Art)

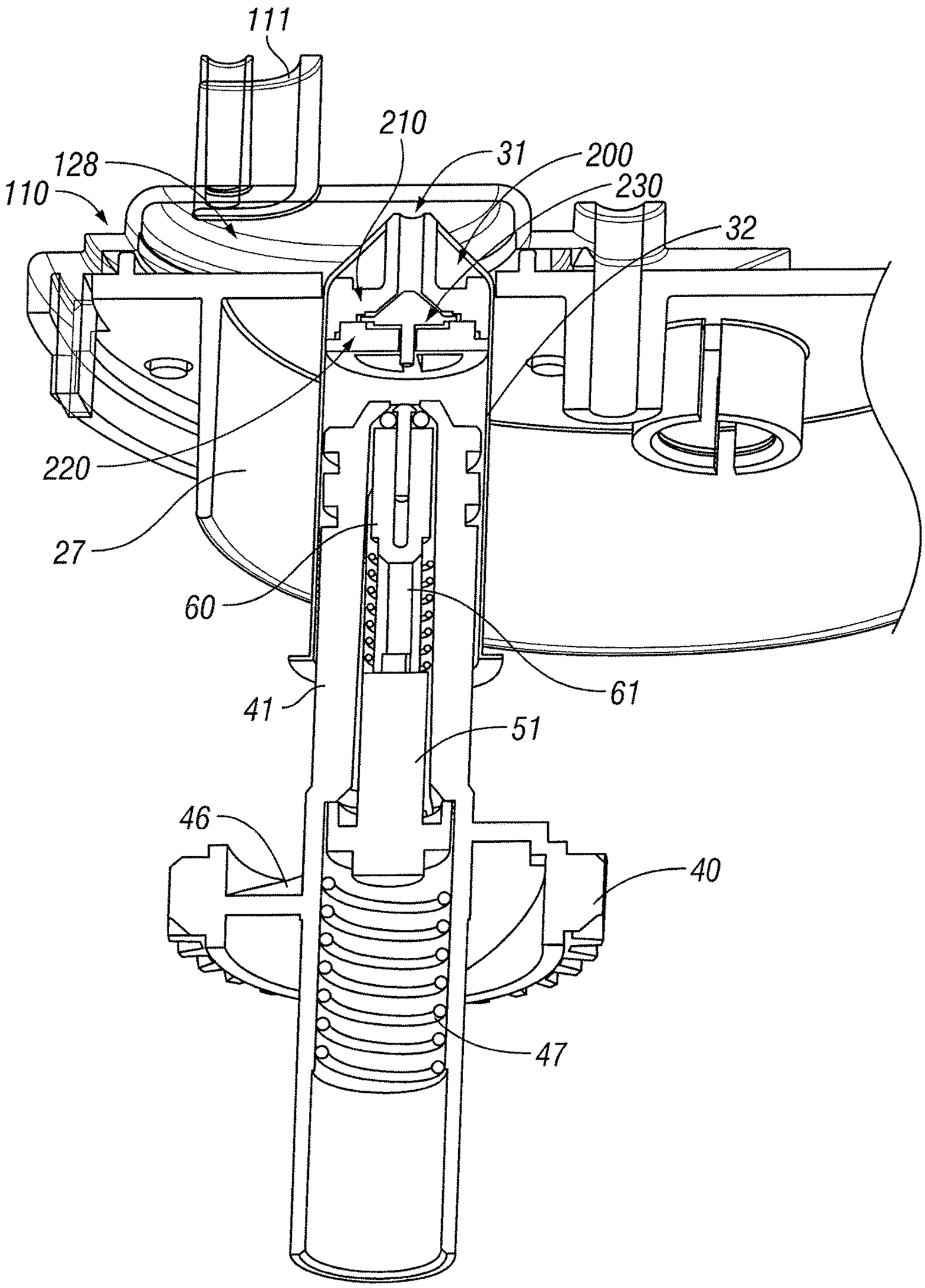


FIG. 4

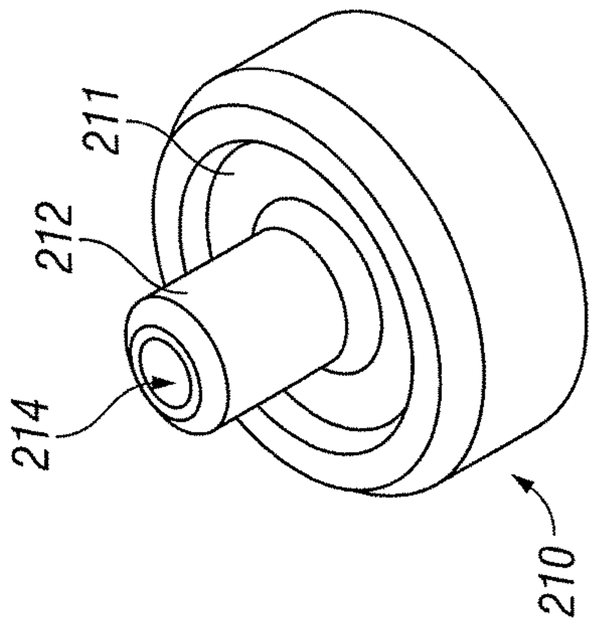


FIG. 5

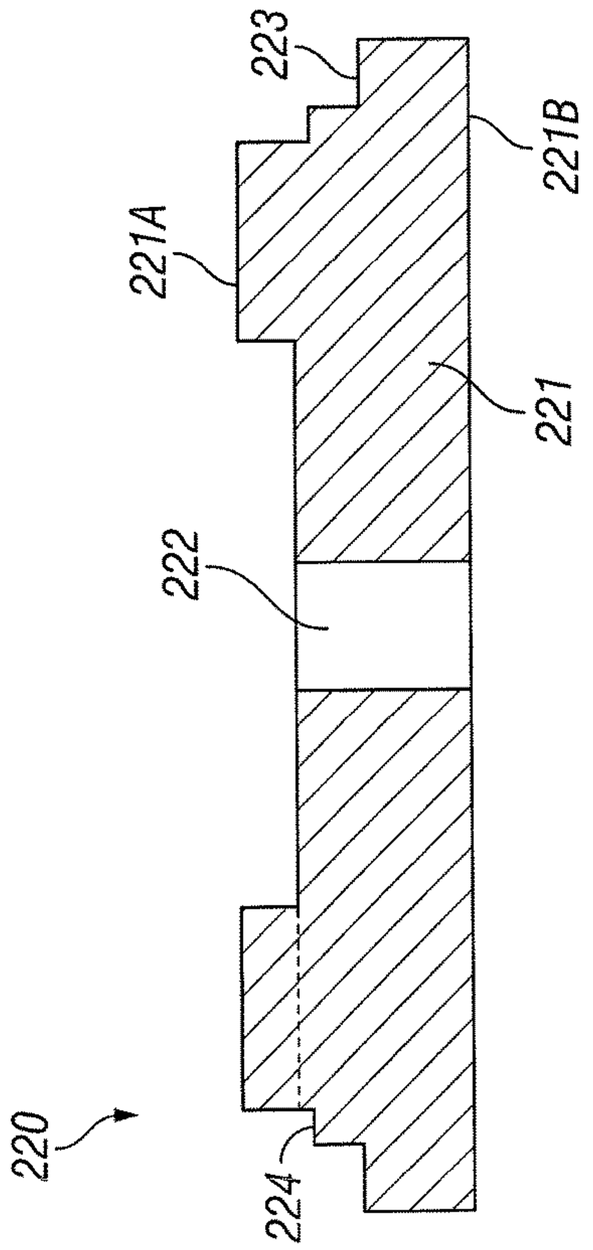


FIG. 7

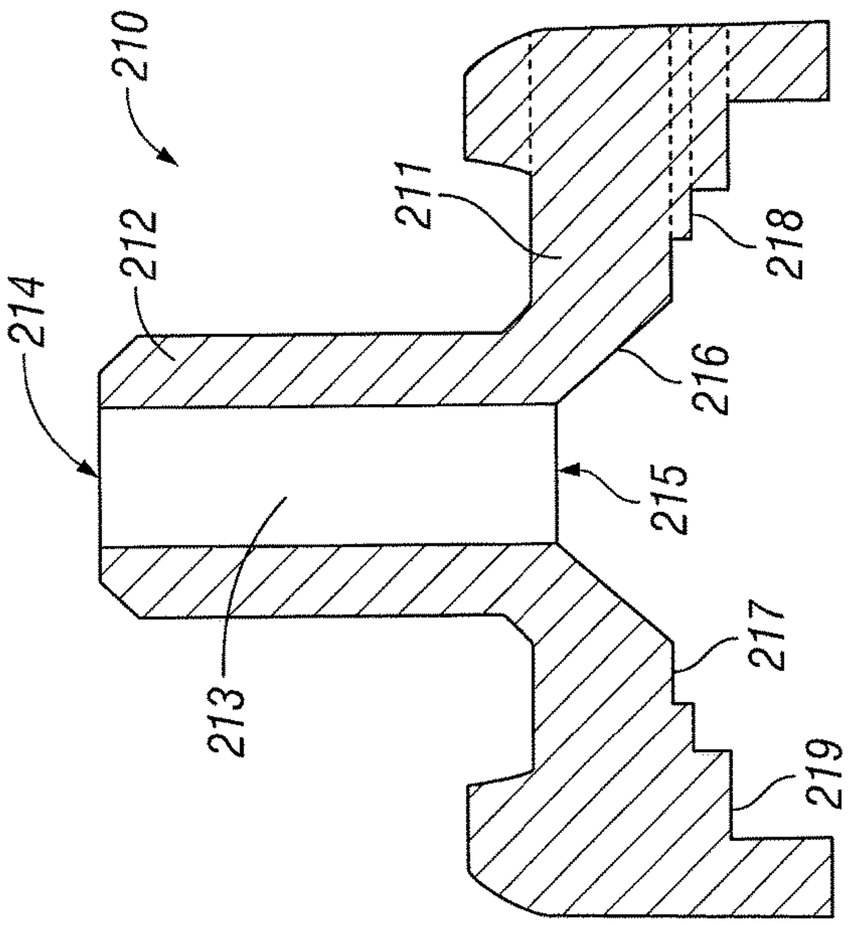


FIG. 6

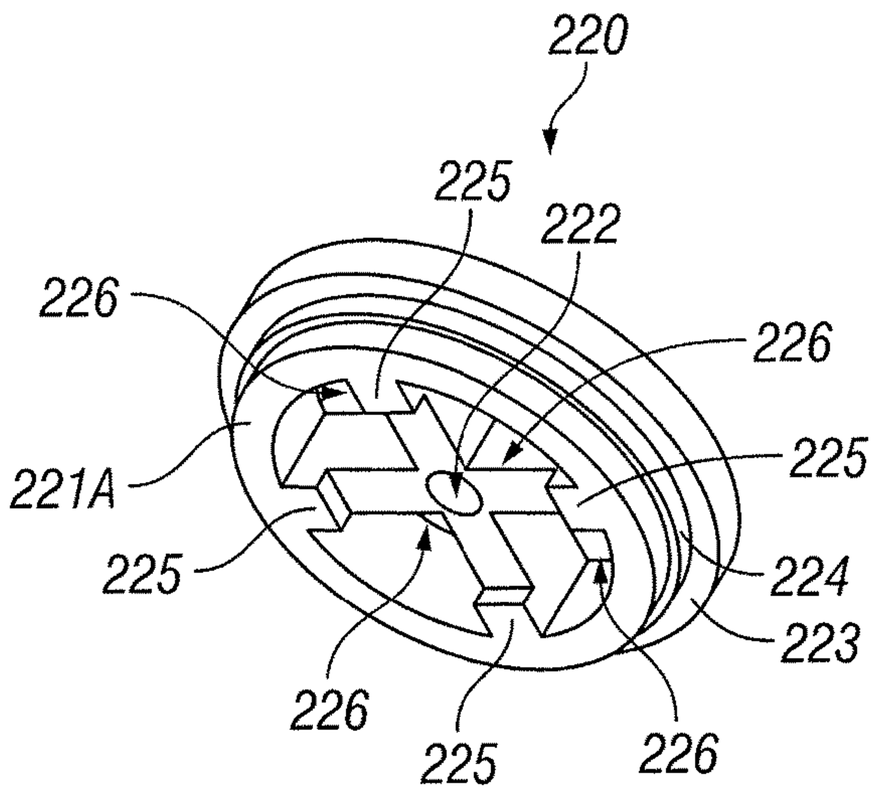


FIG. 8

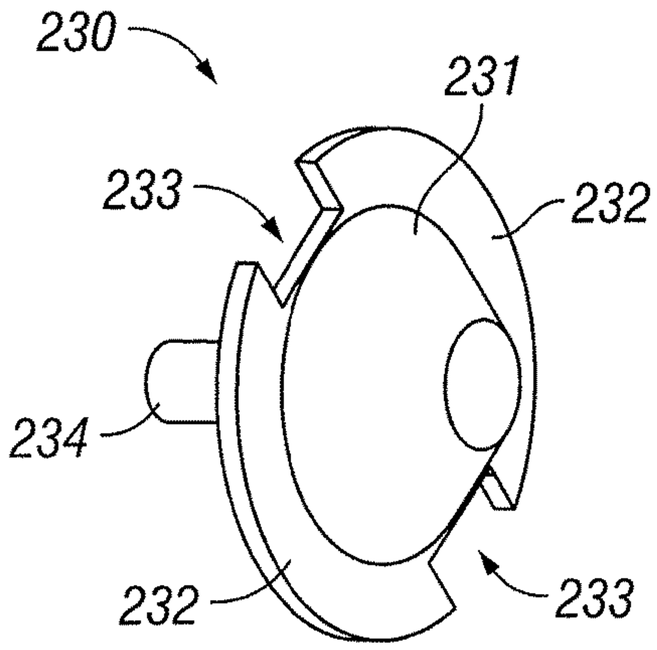


FIG. 9

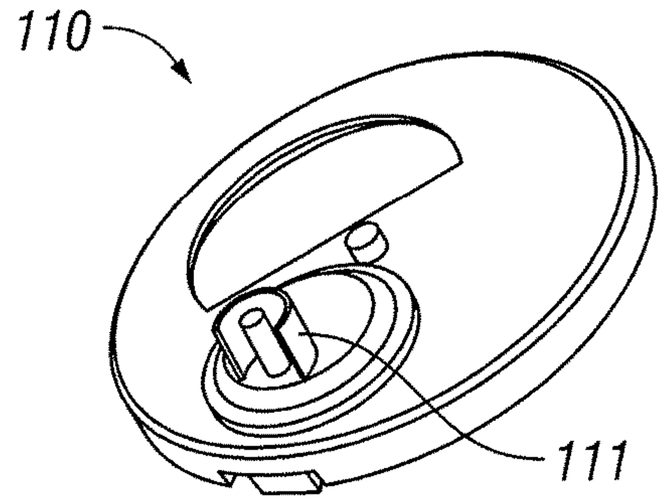


FIG. 10

APPARATUS FOR ADDING FERTILIZER TO WATER IN A SPRINKLER SYSTEM

BACKGROUND AND SUMMARY OF THE INVENTION

In one embodiment of the present invention, an apparatus for injecting liquid fertilizer into a water flow line in a sprinkler system, includes an injector mechanism body having a water inlet and a water outlet adapted to be connected in the water flow line of the sprinkler system so that water flows through at least a portion of the injector mechanism body, a plunger chamber, a plunger movably positioned in the plunger chamber, a paddle wheel positioned to be rotated by water flowing through the injector mechanism body, a plunger gear coupled to the paddle wheel and the plunger so as to rotate when the paddle wheel rotates so as to move the plunger back and forth within the plunger chamber and a valve assembly secured at a fixed location in the plunger chamber.

In one embodiment of the present invention, the valve assembly includes a first retaining member, a second retaining member and a valve member positioned in a space between the first and second retaining members. In one embodiment, the valve member is moveable in the space between the first retaining member and the second retaining member.

In another embodiment of the present invention, the valve member and the first retaining member each include a conical surface and the conical surface of the valve member seals against the conical surface of the first retaining member so as to prevent fluid flow through the valve assembly in at least one direction.

In yet another embodiment of the present invention, the valve member includes a flange, the second retaining member includes a projection and the flange of the valve member is supported on the projection so as to provide a fluid flow path around the flange. In one embodiment, the valve member includes two flanges separated by two notches, the second retaining member includes four projections and two of the projections engage the notches of the valve member and the remaining two projections support the flanges of the valve member so as to form fluid flow paths around the flanges.

In another embodiment, the valve assembly permits fluid flow in only one direction.

Additional features will become apparent to those skilled in the art upon consideration of the following detailed description of embodiments of the invention and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side view of a prior art liquid fertilizer injector apparatus.

FIG. **2** is a vertical section through the injector apparatus shown in FIG. **1**.

FIG. **3** is an exploded view of certain components of the injector apparatus shown in FIG. **1**.

FIG. **4** is a sectional view of certain components of a liquid fertilizer injector apparatus according to one embodiment of the present invention.

FIG. **5** is a perspective view of a first retaining member that is a component of the liquid fertilizer injector apparatus shown in FIG. **4**.

FIG. **6** is a sectional view through the first retaining member shown in FIG. **5**.

FIG. **7** is a perspective view of a second retaining member that is a component of the liquid fertilizer injector apparatus shown in FIG. **4**.

FIG. **8** is a sectional view through the second retaining member shown in FIG. **7**.

FIG. **9** is a perspective view of a valve member that is a component of the liquid fertilizer injector apparatus shown in FIG. **4**.

FIG. **10** is a perspective view of a cover that is a component of the liquid fertilizer injector apparatus shown in FIG. **4**.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

FIGS. **1-3** illustrate a prior art fertilizer injector apparatus more fully disclosed in U.S. Pat. No. 6,997,350, the disclosure of which is hereby incorporated by reference in its entirety, including as part of the disclosure of the present invention. The prior art fertilizer injector apparatus includes a liquid fertilizer reservoir **10**, a lid **11** for the reservoir, an injector mechanism body **12**, a water inlet **13** and water outlet **14** that connect in a sprinkling system water pipe or line (not shown) so that water flowing through the sprinkler system water line to the sprinklers in the sprinkler system flows through a portion of injector mechanism body **12**. Liquid fertilizer reservoir **10** fits onto the top of injector mechanism body **12** and includes two tabs **15** that engage slots **16** on the injector mechanism body **12** to maintain rotational alignment of the reservoir. Note that only one tab and slot is shown in FIG. **2**. The fertilizer injector apparatus further includes an "on" "off" knob **19**.

As shown in FIGS. **2** and **3**, injector mechanism body **12** holds and positions a lower plate **25**, an intermediate plate **26** and a bulkhead **27**. A secondary reservoir **28** is formed between the bottom of reservoir **10** and the top of bulkhead **27** over injector mechanism body **12**. Liquid fertilizer flows through reservoir bottom opening **29** into secondary reservoir **28**. Liquid fertilizer enters a mechanical injection device of the injector mechanism through an inlet **31** in the top of a plunger chamber **32**.

The fertilizer injector apparatus is powered by water flowing through the sprinkler water flow line into water inlet **13**, through a nozzle **35** and across a paddle wheel **36**. The flowing water causes rotation of paddle wheel **36**, here shown to be in a clockwise direction looking downwardly as shown by arrow **36***a*, which, in turn, causes liquid fertilizer from reservoir **10** which flows through secondary reservoir **28** and into plunger chamber inlet **31** to be injected into the water from the sprinkler system water flow line flowing through the apparatus.

The rotating paddle wheel **36**, through shaft **37** rotatably held in lower plate **25**, turns a planetary gear set **38**, held by lower plate **25** and intermediate plate **26**, which, in turn, spins an output pinion **39**. Output pinion **39** extends between and is rotatably held in position by intermediate plate **26** and bulkhead **27**. The revolving output pinion **39** turns plunger gear **40** which is part of and concentric with plunger **41**. Thus, rotation of plunger gear **40** causes rotation of plunger **41**.

As plunger gear **40** rotates, it rotates against a ratchet **42** that is held stationary against the clockwise rotation of plunger gear **40** by a pawl arm **43** of pawl **44**. Ratchet **42** has slanted ratchet tabs **45** extending downwardly from the bottom thereof. The slanted ratchet tabs **45** act as ramps for similarly slanted plunger tabs **46** extending upwardly from plunger gear **40**. The confronting camming surfaces of

ratchet tabs **45** and the plunger tabs **46** push against one another as the plunger gear rotates in relation to the ratchet and force plunger **41** to move downwardly against the bias of a plunger spring **47** within plunger central bore **48**. The lower end of plunger spring **47** is supported by a spring retainer **49** that rotates freely on a post **50** projecting from the lower plate **25**. As plunger **41** rotates, plunger spring **47** and spring retainer **49** freely rotate with it. A spring guide **51** engages the top of plunger spring **47** and shoulder **52** in plunger central bore **48** to compress plunger spring **47** as plunger **41** moves downwardly.

Plunger **41** slides in plunger chamber **32** which connects through plunger chamber inlet **31** to liquid fertilizer secondary reservoir **28** so that liquid fertilizer held in secondary reservoir **28** flows into a space **55** between plunger chamber inlet **31** and the top of plunger **41**. A buoyant check ball **56**, made of a material, such as plastic, that floats in water and liquid fertilizer, is positioned in a narrowed, conical entrance **58** from secondary reservoir **28** to space **55** to form a check valve to prevent reverse flow of liquid fertilizer from plunger chamber space **55** back into secondary reservoir **28** and reservoir **10**. As plunger **41** rotates and moves downwardly in plunger chamber **32**, liquid fertilizer flows by gravity from secondary reservoir **28** past check ball **56** into the space **55**. As liquid fertilizer fills space **55**, check ball **56** floats and rises against narrow conical entrance **58**. In the prior art device, it has been found that the liquid fertilizer reservoir **10** should be positioned above the injection mechanism housing so that the liquid fertilizer can flow by gravity into the plunger chamber.

As indicated, rotation of paddle wheel **36** causes rotation of plunger gear **40**. This rotation causes interaction of plunger tabs **46** and ratchet tabs **45** to cause plunger **41** to move downwardly and allow liquid fertilizer to flow into space **55**, which space enlarges as plunger **41** moves downwardly in plunger chamber **32**. As the plunger tabs **46** reach the top of ratchet tabs **45**, continuing rotation of plunger gear **40** causes the plunger tabs to fall off the ratchet tabs. The plunger spring **47** then forces plunger **41** upwardly in plunger chamber **32**. Flow of liquid fertilizer from plunger chamber **32** back into secondary reservoir **28** is blocked by check ball **56**. Therefore, the plunger **41** moving upwardly in plunger chamber **32** puts the liquid fertilizer trapped in space **55** under pressure. A check pin **60** in the end of plunger **41** is held in normally closed position closing the upper end of plunger central bore **48**, which forms a flow passage for the liquid fertilizer through plunger **41**, by check spring **61**. The bottom of check spring **61** is supported in plunger central bore **48** by spring guide **51** while the top of check spring **61** rests against check pin **60**. The plunger spring **47** is stronger than check spring **61** so overcomes the sealing force of check spring **61** on check pin **60** by exerting pressure to force plunger **41** upwardly. This pressurizes the liquid in space **55** to the extent that it moves check pin **60** against the bias of check spring **61** so that liquid fertilizer in space **55** flows around check pin **60** into plunger central bore **48**, around post projection **50**, and onto lower plate **25** from where it can flow around the circumference of lower plate **25**. The liquid fertilizer then mixes with the water as the water passing the paddle wheel flows up into this area or as the fertilizer flows down around the circumference of lower plate **25** and into mixing chamber **64** where paddle wheel **36** is located. Check spring **61** has sufficient strength to provide necessary sealing force to check pin **60** to prevent the liquid fertilizer from being sucked downwardly from space **55** and secondary reservoir **28** into the mixing chamber **64** if the sprinkler water flow line is ever subject to a negative pressure. As plunger gear **40** continues to rotate, there is a period of noninteraction between the tab camming surfaces until the tabs again meet and interact to again move the plunger gear and plunger downward.

FIG. **4** shows a sectional view of certain components of a fertilizer injector apparatus according to one embodiment of the present invention. In this embodiment of the invention, liquid fertilizer reservoir **10** has been replaced with a cover **110** and check ball **56** has been replaced with a valve assembly **200**. Referring to FIGS. **5** and **6**, valve assembly **200** includes a first retaining member **210**, a second retaining member **220** and a valve member **230**. First retaining member **210** includes a base **211** with a projection **212** extending therefrom. A fluid passageway **213** has a first open end **214** and a second open end **215**. The side of base **211** opposite projection **212** has a conical surface **216**, a first stepped surface **217**, a second stepped surface **218** and a third stepped surface **219**.

Referring to FIGS. **7** and **8**, second retaining member **220** includes a base **221** having a central bore **222** extending there through from an upper surface **221**A to a lower surface **221**B, a first stepped surface **223**, a second stepped surface **224**, a plurality of projections **225** and a plurality of open areas **226**. Referring to FIGS. **7** and **8**, second retaining member **220** includes a base **221** having a central bore **222** extending there through from an upper surface **221**A to a lower surface **221**B, a first stepped surface **223**, a second stepped surface **224**, a valve member support surface **225**, a plurality of projections **225** and a plurality of open areas **226**.

Referring to FIG. **9**, valve member **230** is preferably made from a flexible material such as rubber and includes a conical surface **231**, a pair of flanges **232** separated by notches **233** and a post **234** extending from valve member **230** opposite conical surface **231**.

Valve assembly **200** is assembled by positioning valve member **230** such that post **234** extends through central bore **222** of second retaining member **220**, a raised projection **225** is positioned in each notch **233** and the underside of flanges **232** rest on the other two raised projections **225**. First retaining member **210** is positioned over second retaining member **220** and valve member **230** such that flanges **232** are positioned between stepped surface **218** of first retaining member **210** and upper surface **221**A of second retaining member **220**. Note that valve member **230** is not completely pinned in place between first retaining member **210** and second retaining member **220**, but rather can move somewhat between the two. Valve assembly **200** is positioned in plunger chamber **32** as shown in FIG. **5**.

In use, as plunger **41** moves downwardly as described above, liquid fertilizer is drawn into inlet **31**, through fluid passageway **213**, past conical surface **231**, around flanges **232** which are supported on projections **225** and open areas **226** into plunger chamber **32**. As plunger **41** moves upwardly as described above, liquid fertilizer will flow past check pin **60**, through plunger **41** and mix with water as described above. Note that as plunger **41** moves upwardly, the pressurized liquid in plunger chamber **32** causes valve member **230** to move upwardly such that conical surface **231** of valve member **230** seals against conical surface **216** of first retaining member **210**.

Note that because of the close spacing and highly restricted path around sealing member **230**, when plunger chamber **32** is empty a vacuum is created as plunger **41** moves downwardly. This effectively makes the fertilizer injector apparatus of the present invention self-priming in that it can draw liquid fertilizer into the empty plunger

chamber **32**. Note that the prior art device in U.S. Pat. No. 6,997,350 was not self-priming. This is because check ball **56** would fall adjacent the top of check pin **60** if plunger chamber **32** were filled with air and drawing plunger **41** downwardly would not create a vacuum in plunger chamber **32** sufficient to draw in liquid fertilizer through inlet **31**. Thus, use of valve assembly **200** permits liquid fertilizer reservoir **10** to be replaced with a cover **110** (FIG. **10**) having a fitting **111** that can be connected to a hose (not shown) which is in turn connected at its opposite end to or which has its opposite end placed in a bottle or other container of liquid fertilizer. The vacuum created by use of valve assembly **200** is sufficient to draw liquid fertilizer from the container, through the hose, through fitting **111** and into secondary reservoir **128**.

Note also that use of valve assembly **200** permits orientation of the fertilizer injector apparatus of the present invention in any orientation. This is because valve assembly **200** is fixed in place in plunger chamber **32**. Thus, valve member **230** is fixed in the orientation which will provide the desired sealing function and which will permit desired flow at the appropriate times regardless of orientation of the fertilizer injector apparatus. This is not true of the prior art device. For example, orienting the prior art device on its side would result in check ball **56** being displaced from inlet **31** and positioning itself on the interior surface of plunger chamber **32** away from inlet **31**.

Although the present invention has been shown and described in detail, the same is to be taken by way of example only and not by way of limitation. Various alterations and modifications can be made to the embodiments discussed above without departing from the spirit and scope of the invention.

What is claimed is:

1. An apparatus for injecting liquid fertilizer into a water flow line in a sprinkler system, including:

an injector mechanism body having a water inlet and a water outlet adapted to be connected in the water flow line of the sprinkler system so that water flows through at least a portion of the injector mechanism body;

a plunger chamber;

a plunger movably positioned in the plunger chamber;

a paddle wheel positioned to be rotated by water flowing through the injector mechanism body;

a plunger gear coupled to the paddle wheel and the plunger so as to rotate when the paddle wheel rotates so as to move the plunger back and forth within the plunger chamber; and

a valve assembly secured at a fixed location in the plunger chamber, the valve assembly including a valve member having a conical surface, a first flange, a second flange and first and second notches separating the first and second flanges, first means for retaining the valve member in the plunger chamber and second means for retaining the valve member in the plunger chamber, the first means for retaining having a conical surface, the second means for retaining having two projections engaging the notches of the valve member and two projections supporting the first and second flanges of the valve member so as to form fluid flow paths around the flanges and wherein the conical surface of the valve member seals against the conical surface of the first means for retaining so as to prevent fluid flow through the valve assembly in at least one direction.

2. The apparatus for injecting liquid fertilizer according to claim **1**, further including a space between the first and second means for retaining and wherein the valve member is moveable in the space.

3. The apparatus for injecting liquid fertilizer according to claim **1**, wherein the valve assembly permits fluid flow in only one direction.

* * * * *