United States Patent [19]

Lewis

[11] **3,730,208**

[45] **May 1, 1973**

[54] **MULTIPLE OUTLET FLUID DISTRIBUTION APPARATUS**

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[22] Filed: **Apr. 29, 1971**

[21] Appl. No.: **138,674**

[52] **U.S. Cl.** **137/119,** 137/624.14, 137/205.5, 137/625.11

[51] **Int. Cl.** **F16k 11/02**

[58] **Field of Search** 137/624.14, 624.18, 137/624.2, 625.11, 119, 205.5

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[57] **ABSTRACT**

A flexible disc-like valve member is rotatably mounted within a shell to selectively seal fluid outlets from the shell and to selectively open the outlets through an arc-shaped slot in the valve. The shell includes a hemispherical portion, a spherical zone section joining the hemispherical portion at the latter's equator, and a circular plate-like bottom closing the spherical zone. Radially extending reinforcing ribs extend out to the limits of the sphere from the bottom to give the entire shell the integrity of a sphere. An impeller driven gear train drives the flexible disc. Each of the outlets is long and thin and is bounded by a raised ramp-like protrusion which is feathered such that along a common line from the center of the disc larger radii encounter the ramp first.

14 Claims, 5 Drawing Figures

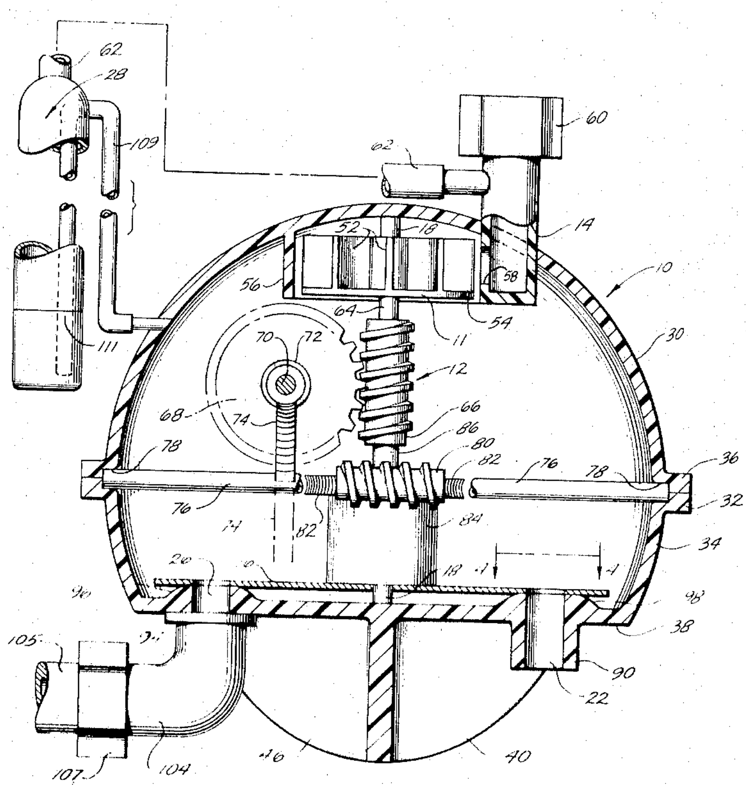

FIG. 1

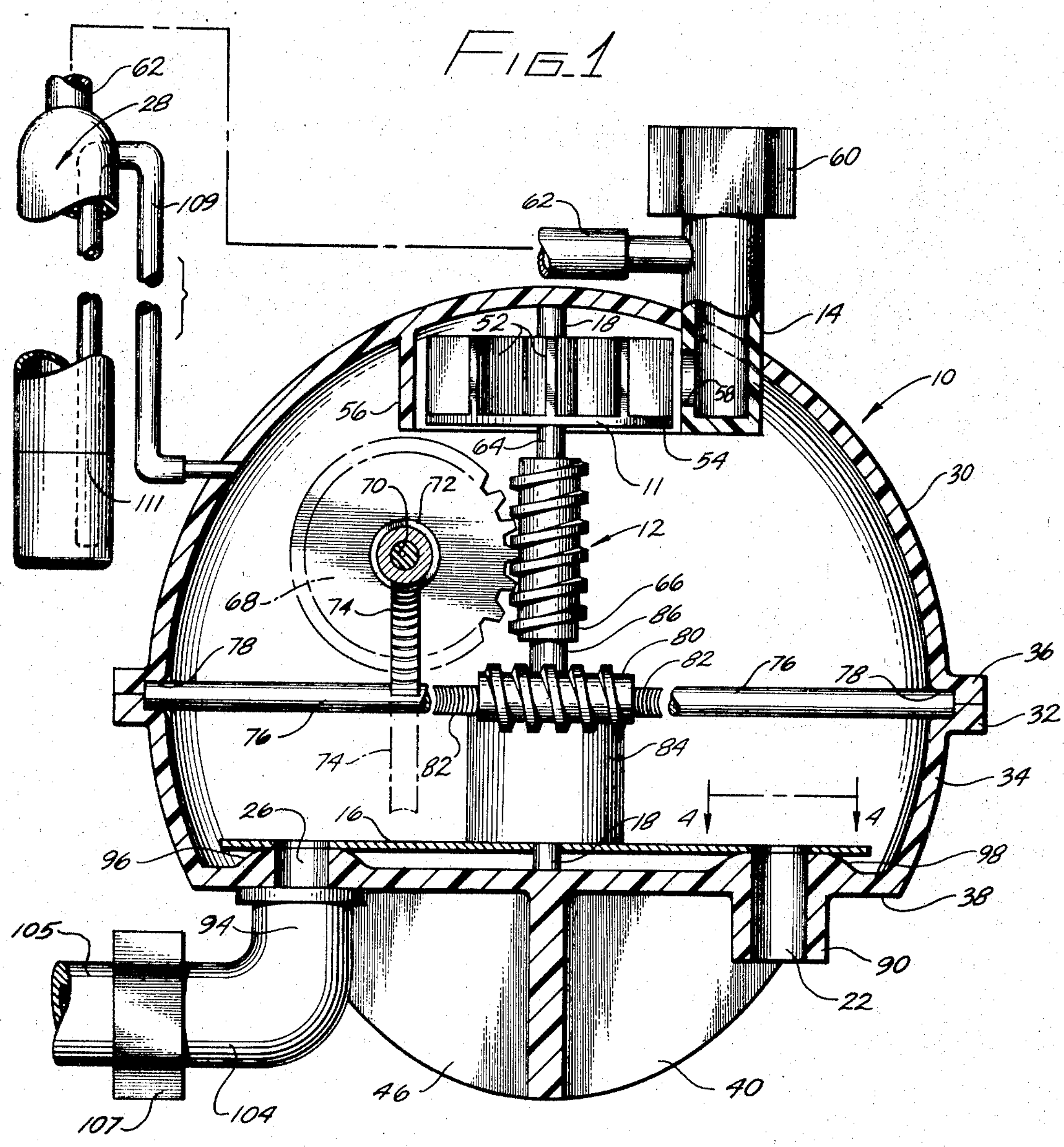

FIG. 3

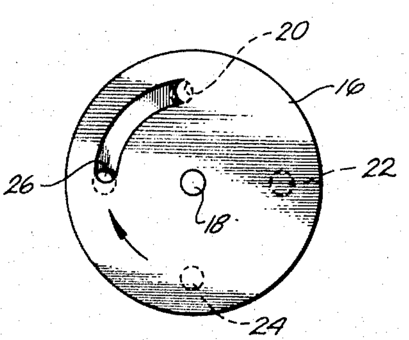

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FIG. 2

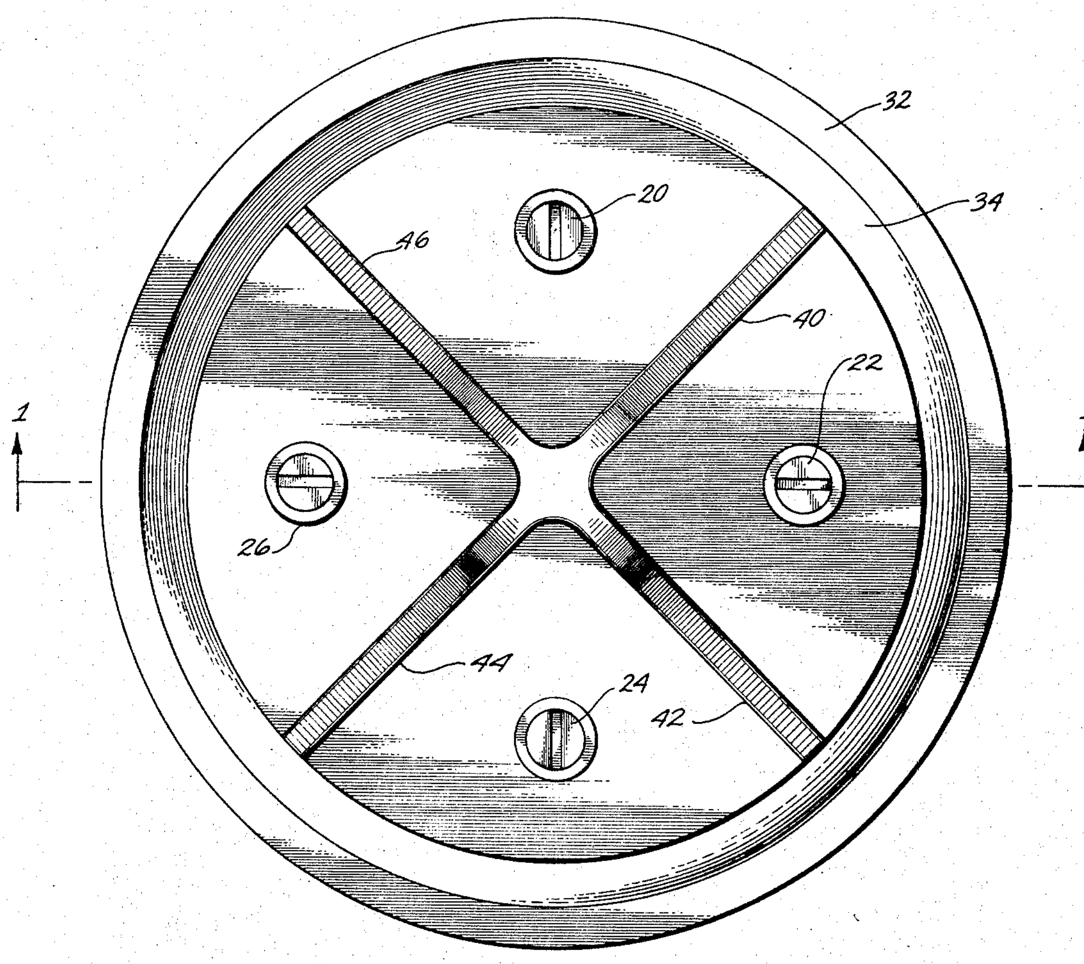


FIG. 4

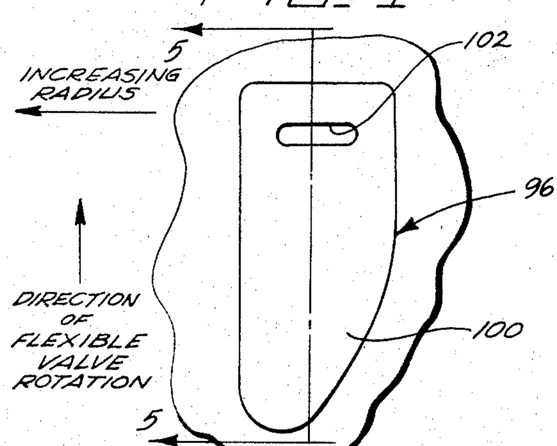
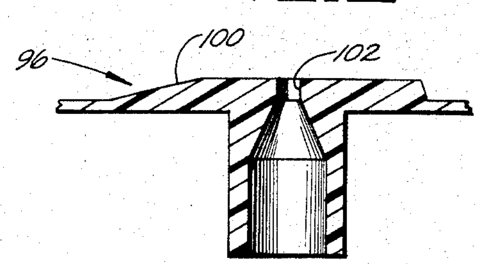


FIG. 5



MULTIPLE OUTLET FLUID DISTRIBUTION APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to fluid distribution systems in particular and has a particularly useful application in home and commercial water sprinkler systems.

The usual home and commercial ground sprinkling systems have a plurality of independently operated sprinkler circuits. Because of the available water pressure, only one circuit is used at a time. The operator must, therefore, actuate each circuit individually to water his grounds. This mode of ground watering is particularly annoying when repetitive sprinkling of a given area with a soak period between each sprinkling is undertaken. Though some systems have recently been introduced which are totally automated, the cost of such systems makes them unattractive for modest budgets.

There have been devices proposed to effect cyclic sprinkling without undue operator attention. These devices, through a timing gear train or the like, typically driven by water pressure, switch from one circuit to another. One such device uses an impeller to drive a reducing gear train which in turn drives a solid, slotted wheel which periodically registers with water outlets.

Unfortunately, prior art devices have not proven entirely satisfactory in every particular. Oftentimes the devices are too expensive. Oftentimes the devices because of their complexity are not as reliable as would be liked. Another example of the inadequacies of the prior art devices is that because of one design limitation or another, the devices are easily broken by rough handling.

SUMMARY OF THE INVENTION

The present invention provides a fluid distribution apparatus which is capable of use with a multiple circuit fluid distribution system while effectively sealing outlets not in use and which is continuously operable so long as fluid pressure is available.

In one form the present invention contemplates a fluid tight housing or shell having a plurality of fluid outlets opening into the interior of the housing at a planar inner surface. A fluid inlet is provided to communicate the interior of the housing with a source of pressurized fluid, typically water under pressure. A rotary valve of flexible low friction material, such as polyethylene about 0.020 to 0.050 inch thick, is mounted for rotation in the housing adjacent the inner planar surface through which the fluid outlets extend. The upper surface of the flexible rotary valve covers and is urged against the outlets by fluid pressure in the housing. An opening is provided, preferably in the form of an elongated slot, in the flexible rotary valve and is disposed to successively communicate each outlet with the housing's interior as the valve rotates. Means are provided, for example an impeller and gear train, for rotating the valve in response to fluid admitted under pressure into the housing through the fluid outlet.

To avoid the possibility of impeller stall and apparatus shutdown, it is preferred to have the slot configured to communicate a different one of the outlets with the interior of the housing at all times. In short, there will be some overlap between successive outlets until a succeeding outlet is fully on line. The slot can be configured in such a manner as to effect constant outlet area even during the time when two outlets are open. This constancy in area gives constant pressure which ensures complete ground coverage.

It is preferred that at each outlet a ramp-like protrusion be provided. This protrusion extends from the floor of the shell to meet the flexible rotary valve member. The protrusion has a feathered leading edge which presents to a line extending radially from the rotational center of the valve an encounter with the protrusion first at larger radii and then an increasing encounter as the outlet is approached for smaller radii. The outlet itself where it opens into the interior of the housing is relatively thin and long, with the long portion of the outlet being radially oriented with respect to the rotational axis of the rotary valve.

It is known that optimum ground watering of a given area requires repetitive watering interspersed with periods of soak. In order to have sufficient soak and watering times it is necessary to rotate the rotary valve very slowly. This is accomplished in the present invention by using a fluid driven impeller and gear train combination which employs a plurality of worms and worm gears. Economy in space and in parts is effected through the use of drive shafts or axles in one portion of the system for support of another portion of the gear train. For example, a support axle for the impeller can also support a worm the impeller drives and be anchored at its ends to the shell. But the same support axle can be used to support a worm gear in the final stages of the drive. This is done by having the appropriate gear train components received by the support axle for rotation with respect to it.

The shell or housing of the present invention is preferably in the form of a hemisphere attached at its equator to a member having a spherical zone closed by a flat, circular plate-like bottom. The bottom provides for the fluid outlets and is desirable in that its flat configuration ensures that water accumulation within the housing will not occur when the device is not in use. To retain the integrity inherent in a spherical structure, reinforcing ribs are provided and extend radially from the center of the circular bottom to the limits of the sphere. The spherical structural characteristic of the shell resists water pressure from within it.

Another feature of the present invention which has been found particularly suitable is a fertilizer induction device which relies on the difference in pressure upstream and downstream from the impeller to force relatively constant amounts of fertilizer into the housing.

These and other features, aspects and advantages of the present invention will become more apparent from the following description, appended claims and drawings.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is an elevational view mostly in half section of a preferred embodiment of the present invention taken along line 1—1 of FIG. 2;

FIG. 2 is a bottom plan view of the embodiment shown in FIG. 1;

FIG. 3 is a partial view showing the rotary flexible valve of the present invention as it masks and unmasks fluid outlets;

FIG. 4 is a partial view of the protrusion about the fluid outlet; and

FIG. 5 is a view taken along line 5—5 of FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In general the fluid distribution apparatus of the present invention includes a housing or a shell **10** in which is disposed an impeller **11** which drives a gear train **12**. A fluid inlet **14** to impeller **11** provides for the directing of the water which is the impetus for driving the gear train. Ultimately through the gear train a flexible disc-like valve member **16** is driven in rotation about an axle **18**. This disc, as brief reference to FIG. **3** illustrates, selectively masks and unmasks fluid outlets **20**, **22**, **24** and **26**, with the unmasking being through an arcuate slot **27** in the disc. A fertilizer dispensing vessel **28** cooperates with the fluid distribution apparatus and through the pressure differential existing between upstream fluid pressure ahead of the impeller and downstream pressure within the shell admits fertilizer into the shell.

With this general description in mind, a brief description of how the apparatus operates may be constructive before the detailed description is completed. Fluid under pressure entering inlet **14** will drive impeller **11** and gear train **12**. A relatively large amount of gear reduction is necessary for the rather slow rotation of valve disc **16** which, in turn, is necessary for effective watering. A suitable reduction would be in the range from 10,000:1 to 30,000:1. In any event, valve **16** will rotate slowly to progressively unmask and mask fluid outlets **20**, **22**, **24** and **26** for the changing of the fluid circuits which are being serviced by the apparatus. If desired, fertilizer vessel **28** can be in circuit also. Fertilizer in the fertilizer vessel is forced into shell **10** by the pressure differential between the upstream and downstream sides of impeller **11**. It must be appreciated that the head of the fluid coming in through the inlet is slightly higher than that existing within the shell because of the energy required by the gear train. In any event this pressure differential has been found sufficient to force fertilizer in the fertilizer vessel into the interior of the shell for mixing with water there and for its subsequent discharge out of the fluid outlets.

Progressing to a more detailed description of the present invention, the shell or housing **10** comprises a generally hemispherical section **30** which at its equator (marginal edge) meets a circular flange **32** of spherical zone section **34** at its own circular flange **36**. The zone section in turn is capped by a circular plate-like bottom portion **38** of the shell. Four reinforcing ribs **40**, **42**, **44** and **46** extend from an axis extending through the center of bottom portion **38** and normal to it radially to the limits of the sphere which would have resulted had bottom half of the shell been hemispherical. Thus the basic shell is generally spherical in appearance, but what is more important insofar as its structural characteristics are concerned, it has the structural characteristics of a sphere. This means that the shell can be made of relatively thin material and the shell can take considerable physical abuse and internal water pressure.

Impeller **11** will now be described. Impeller **11** is mounted for rotation about stationary axle **18**. The impeller has a hub **50** for its mounting on this axle and a plurality of blades **52** extending generally radially of the hub. A circular side **54** of the impeller keeps water

in the channels between the blades. A shroud **56** circumscribes the outer peripheral limits of the impeller. The shroud is open at its bottom for the discharge of water from the impeller channels into the cavity defined within the shell.

Inlet **14** extends into the interior of shell **10** for a distance from its attachment to hemispherical portion **30** and has an outlet proper **58** oriented to direct water under pressure against the blades of the impeller to cause the latter to rotate. An appropriate fitting, for example, female fitting **60**, may be employed for attaching the inlet to a source of water, for example, a hose. From the inlet a line **62** extends for developing a pressure in the upper portion of fertilizer vessel **28**. This will be described in detail subsequently.

Gear train **12** will now be described. Impeller **11** is journaled on axle **18** and is attached to a hollow axle **64**. Through the hollow axle, the impeller drives a first worm **66**. First worm **66** is received on axle **18** and is supported vertically as by a hollow sleeve extension **86** of the worm. Axle **18** extends between its anchors on the interior of hemisphere **30** to the bottom plate **38**. First worm **66** drives a first worm gear **68**. First worm gear **68** is secured to and positioned by a rotatable axle **70**. The securing of the various worms and worm gears to their axles, incidentally, can be done in a number of ways, e.g., solvent weld, keying, and fusion, the choice being dependent on the materials chosen for these parts. It may be desirable to mold axles and their gears as one plastic piece. The first worm gear drives a second worm **72** through axle **70** to which the second worm is secured. The second worm in turn drives a second worm gear **74** which is secured to a third axle **76**. The third axle is supported for rotation in axle bearing pockets **78** defined within flanges **32** and **36** between the hemispherical section and the spherical zone section of the shell. A similar axle pocket arrangement, though with interior bosses, rotatably supports axle **70**. Second worm gear **74** through axle **76** drives third worm **80**, which in turn drives third worm gear **82**. This third worm gear is attached to a hub **84** which in turn is attached to flexible valve member **16**. As previously mentioned, valve member **16** is also supported by axle **18** from bottom **38**. It should be noted here that the requisite end constraint for first worm **66** is provided by axle **18**. The requisite end constraint for third worm gear **82** is also provided by axle **18**. But during operation, worm **66** rotates much faster than worm gear **82**. This utilization of a common axle for support minimizes the number of parts necessary in the fluid distribution apparatus.

The fluid outlet system will now be described. As is illustrated specifically in FIGS. **2** and **3**, the illustrated embodiment of the present invention has four fluid outlets, **20**, **22**, **24** and **26**. Each of these fluid outlets is adapted to supply a separate fluid distribution circuit. As previously mentioned, it is highly desirable to progress from one circuit to another in sprinkling applications and then come back to a circuit which was previously on the line. This provides alternate periods of sprinkling and soaking which, as is well known, is highly effective. In any event, the outlets begin within the confines of shell **10**. The outlets are bordered at their mouths by ramp-like protrusions shown for outlets **22** and **26** in FIG. **1** at **96** and **98**, respectively.

Each of the outlets is identical and therefore the description of outlet **22** attendant with FIGS. **4** and **5** will do for all the outlets.

With reference to FIG. **4**, protrusion **96** is illustrated in plan from above. It is noted here that the ramp-like protrusion is feathered at **100** in such a manner that a straight line from the center of valve disc **16** will encounter the feather first at larger radii, with progressively larger contact along shorter radii as the line rotates. In other words, the line will encounter the protruding ramp progressively and increasingly starting at larger radii and continuing to shorter radii along the same line until finally the entire radial width of the ramp-like protrusion is encountered proximate the long, narrow, radially oriented mouth **102** of the outlet. This configuration is also shown in FIG. **5**. It has been found that the protruding sections of this geometry provides extremely effective seal action against the flexible valve member and also reduces the amount of friction encountered by the valve member as it rotates, particularly as the trailing edge of slot **27** rides up and over the protrusions.

Typical external outlet hardware is illustrated in FIG. **1**. There an elbow **104** is secured to an externally protruding portion of the outlet in any convenient manner. The elbow has threaded onto it a hose or the like **105** as by female fitting **107** threaded onto complementary threads of the elbow.

Fertilizer vessel **28** combines with the balance of the fluid distribution apparatus to introduce fertilizer into the interior of shell **10** for mixing with water there. It has been found that at least with fertilizers having a specific gravity greater than water that the fertilizer tends to remain unmixed and therefore will be metered into the interior of the shell at relatively constant rates. In the specifically illustrated embodiment a line **62** connects the top of vessel **28** with a water pressure source, inlet **14**, upstream from impeller **11**. An outlet **109** from the bottom of the inside of vessel **28** to the interior of shell **10** communicates the fertilizer vessel with the interior of the vessel. Line **109** is arranged in vessel **28** so that only differentials in pressure and not gravity will force fluid through it. In short, line **109** is arranged as a dip tube in vessel **28**. A line **111** denotes a typical interface between water and fertilizer in vessel **28**. The pressure differential between the upstream and downstream sides of impeller **11** is sufficient to force fertilizer from vessel **28** into the interior of shell **10** where it mixes with water and is discharged out the outlets with the water.

The present invention has been described with reference to a certain preferred embodiment. The spirit and scope of the appended claims should not, however, necessarily be limited to the foregoing description.

What is claimed is:

1. A multiple outlet fluid distribution apparatus comprising:

a. a fluid tight housing having at least one planar inner surface, a fluid inlet and a plurality of fluid outlets, the outlets opening into the housing through the planar inner surface, the housing being a shell of a hemispherical top portion, a spherical zone portion joining the top portion at the latter's marginal edge, and a circular, flat bottom portion joining the spherical zone portion and closing the shell, the planar inner surface being on the flat bottom portion;

b. a rotary valve of flexible material mounted for rotation in the housing adjacent the planar inner surface having a lower surface covering the outlets, an upper surface in fluid pressure communication with the interior of the housing and an opening between the two surfaces capable of successively communicating each outlet with the housing's interior upon rotation of the valve; and

c. means for rotating the valve in response to fluid admitted under pressure into the housing through the fluid inlet.

2. The multiple outlet fluid distribution apparatus claimed in claim **1** wherein:

the fluid outlets and the opening in the rotary valve are disposed and arranged with respect to each other such that at least one of the outlets is in communication with the interior of the housing at all times.

3. The multiple outlet fluid distribution apparatus claimed in claim **2** wherein:

an annular protrusion is disposed about the entrance of each of the fluid outlets within the housing to provide a seal against fluid leakage into the outlets which are out of communication with the housing's interior.

4. The multiple outlet fluid distribution apparatus claimed in claim **1** wherein:

a. the outlets are disposed along the circumference of an imaginary circle equidistant from each other;

b. the rotary valve's opening is defined by a slot which is capable of registering with each of the outlets individually and with at least one outlet at all times; and

c. the means for rotating the valve include:

i. an impeller assembly having an impeller and a shroud, the shroud being within the housing and having a fluid outlet into the interior thereof, the impeller being rotatably mounted in the shroud with the shroud circumscribing in close proximity the outer radial periphery of the impeller, the fluid inlet opening into the shroud such that fluid under pressure admitted therethrough is capable of driving the impeller in rotation and admitting fluid into the housing's interior for subsequent discharge through the outlets; and

ii. a gear train mounted in the housing operatively coupled to the impeller and the rotary valve, the gear train being operable to drive the rotary valve in rotation at a revolution rate considerably lower than the revolution rate of the impeller.

5. The multiple outlet fluid distribution apparatus claimed in claim **4** wherein the gear train includes a plurality of worm and meshing worm gear pairs between the impeller and the rotary valve.

6. The multiple outlet fluid distribution system claimed in claim **5** wherein there are at least three pairs of the worm and worm gear on axles, the first worm of the first pair being partially supported by the axles of the third worm gear.

7. The multiple outlet fluid distribution apparatus claimed in claim **1** including a plurality of ribs extending radially from the center of the bottom portion ex-

ternally of the shell to the limits of the spherical curvature of the hemispherical and spherical zone portions of the shell.

8. The apparatus claimed in claim **4** including a vessel having a fluid inlet in fluid communication with the inlet to the impeller upstream therefrom and a fluid outlet in fluid communication with the interior of the housing downstream from the impeller.

9. A multiple outlet fluid distribution apparatus comprising:

a. a fluid tight housing having at least one planar inner surface, a fluid inlet and a plurality of fluid outlets, the outlets opening into the housing through the planar inner surface;

b. a rotary valve of flexible material mounted for rotation in the housing adjacent the planar inner surface having a lower surface covering the outlets, an upper surface in fluid pressure communication with the interior of the housing and an opening between the two surfaces capable of successively communicating each outlet with the housing's interior upon rotation of the valve;

c. means for rotating the valve in response to fluid admitted under pressure into the housing through the fluid inlet; and

d. an annular protrusion disposed at the entrance to each of the fluid outlets, each of the protrusions having a feathered leading edge which in extent progressively increases in the direction of valve rotation toward the outlet.

10. The multiple outlet fluid distribution apparatus claimed in claim **9** wherein the feathered edge of each of the protrusions is ramp-like and disposed such that a straight line from the center of rotation of the rotary valve will encounter the feather initially at larger radii and progressively increase the encounter at smaller radii.

11. The multiple outlet fluid distribution apparatus claimed in claim **10** wherein the opening in the rotary valve and the outlets are disposed and arranged with respect to each other so that at least one of the outlets is in communication with the interior of the shell at all times.

12. A multiple outlet fluid distribution apparatus comprising:

a. a fluid tight housing having at least one planar inner surface, a fluid inlet and a plurality of fluid outlets, the outlets opening into the housing through the planar surface;

b. a rotary valve mounted for rotation in the housing adjacent the planar inner surface having a lower surface covering the outlets, an upper surface in fluid pressure communication with the interior of the housing and an opening between the two surfaces capable of successively communicating each outlet with the housing's interior upon rotation of the valve; and

c. means for rotating the valve in response to fluid admitted under pressure into the housing through the fluid inlet, the rotation means including:

i. an impeller assembly having an impeller and a shroud, the shroud being within the housing and having a fluid outlet into the interior thereof, the impeller being rotatably mounted in the shroud with the shroud circumscribing in close proximity the outer radial periphery of the impeller, the fluid inlet opening into the shroud such that fluid under pressure admitted therethrough is capable of driving the impeller in rotation and admitting fluid into the housing's interior for subsequent discharge through the outlets; and

ii. a gear train mounted in the housing operatively coupled to the impeller and the rotary valve, the gear train being operable to drive the rotary valve in rotation at a revolution rate considerably lower than the revolution rate of the impeller.

13. The multiple outlet fluid distribution apparatus claimed in claim **12** wherein:

the fluid outlets and the opening in the rotary valve are disposed and arranged with respect to each other such that at least one of the outlets is in communication with the interior of the housing at all times.

14. The multiple outlet fluid distribution apparatus claimed in claim **13** including a fluid inlet for an auxiliary fluid distribution vessel in fluid communication with the inlet to the impeller upstream therefrom, and a fluid outlet for the auxiliary vessel in fluid communication with the interior of the housing downstream from the impeller.

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