FLOW SWITCHING VALVE

1. A fluid flow valve is disclosed for sequentially switching an incoming fluid stream through each of a plurality of outlet ports. An impeller is disposed for angular rotation within the valve and turns in response to the flow of fluid. The impeller is connected to a rotor by means of a planetary gear train. The rotor operates a cam which opens one segment of a multi-segmented plate associated with the outlet ports, thereby allowing fluid flow through the selected outlet ports.

12 Claims, 14 Drawing Figures
FLOW SWITCHING VALVE
CROSS REFERENCE

This application is a continuation-in-part of my co-pending application entitled "Flow Switching Valve," Ser. No. 79,724, filed Oct. 12, 1970 now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention pertains to valves and more particularly to a fluid flow switching valve which directs the fluid sequentially from one outlet port to another, the switching rate being in direct proportion to the flow rate.

2. Description of the Prior Art

In the art of handling fluids which flow through pipelines, conduits, and the like, it is often desirable that the flow from a trunk line be switched between a plurality of branches or laterals.

Many methods of accomplishing fluid flow switching have been devised, these methods require either elaborate time controlled switching mechanisms, or a plurality of manually controlled valves.

In the art of irrigation and lawn sprinkling systems, the supply pressure in the trunk line dictates the area which may be irrigated or sprinkled at any given time due to the pressure being inversely proportional to the flow. Therefore, if the total area to be irrigated by the system is larger than that which could be supplied by the trunk, the area must be divided into sections and the flow in the trunk periodically switched to one or more of these sections.

A particular prior art method of performing this switching function comprises a plurality of valves, one for each section or lateral, which must be switched manually by an operator. Other more complex, and therefore more expensive, systems of accomplishing this switching operation involve electric timing mechanisms which automatically control the switching operation on a time schedule basis. These prior art systems each have disadvantages in that the manual system must be under constant surveillance and the more elaborate system is comparatively expensive and may require expensive maintenance or servicing.

Therefore, the need exists for an inexpensive automatic flow switching valve.

SUMMARY OF THE INVENTION

The present invention teaches a fluid flow valve for sequentially switching the fluid entering an inlet port to each of a plurality of outlet ports. A fluid flow sensing means, such as an impeller, is disposed within the valve and rotates in response to the entering fluid flow. The rotating impeller is operably connected to a rotor by means of a planetary gear train. The rotor actuates a cam, which cam engages at least one segment of a multisegmented plate. Each of the segments is associated with one of the outlet ports and the engagement of the cam with any one segment establishes a fluid flow from the inlet port through the corresponding outlet port.

A primary object of this invention is to provide an automatic fluid flow switching valve which periodically switches fluid flow to a different one of the plurality of outlet ports.

Another object of this invention is to provide an automatic fluid flow switching valve in which the switching rate of the valve is in direct proportion to the rate of fluid flow therethrough.

Another object of the present invention is to provide an automatic fluid flow switching valve having a flow sensing means coupled to a reduction means for controlling a rotor which automatically switches fluid flow to a plurality of outlet ports.

Another object of the present invention is to provide an automatic fluid flow switching valve with a cam actuated flapper valve for switching a flow of fluid to a plurality of outlet ports.

Another object of the present invention is to provide a planetary gear train for operating a cam actuated flapper valve in an automatic fluid flow switching valve.

Another object of the present invention is to provide a self-cleaning fluid flow switching valve.

These and other objects of the present invention will become apparent to those skilled in the art as the description thereof proceeds.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic illustration of an irrigation or lawn sprinkling system containing the valve of the present invention;

FIG. 2 is a side view partially in section to show the mechanism of one embodiment of the present invention;

FIG. 3 is a sectional view taken on line 3—3 of FIG. 2;

FIG. 4 is a sectional view taken on the line 4—4 of FIG. 2;

FIG. 5 is a cross section taken on the line 5—5 of FIG. 6 partially broken away to illustrate the features of another embodiment of the present invention;

FIG. 6 is a sectional view taken on the lines 6—6 of FIG. 5;

FIG. 7 is a sectional view taken on the line 7—7 of FIG. 5;

FIG. 8 is a sectional view taken on the line 8—8 of FIG. 6; and

FIG. 9 is a sectional view taken on the line 9—9 of FIG. 6.

FIG. 10 is a cross sectional view of yet another embodiment of the present invention.

FIG. 11 is a top view of the inside of the base, including the traveling cam, of the invention shown in FIG. 10.

FIG. 12 illustrates the rotor of the invention shown in FIG. 10.

FIG. 13 is a top view of the cam operated flapper valve of the invention shown in FIG. 10.

FIG. 14 is a side view of the cam operated flapper valve of the invention shown in FIG. 10.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With references to FIG. 1, an automatic fluid flow switching valve 10 is shown in an irrigation or lawn sprinkler system 12. It should be understood that the irrigation or lawn sprinkler system 12 was chosen for illustrative and descriptive purposes, as the valve 10 may be employed in any fluid system having the need for switching the flow thereof.

The system 12 is shown as having a trunk or supply line 14 with a manual shut-off valve 16 therein. Trunk 14 is suitably connected to inlet port 18 of valve 10 to supply fluid thereto. The valve 10 is provided with a
plurality of outlet ports 20, the number of which may change to suit particular system requirements. Each outlet port 20 is coupled to a branch or lateral 22 each of which contain a plurality of sprinkler heads 24. The valve 10 is adapted to automatically switch the fluid supplied by trunk 14 to each of the individual laterals 22. The automatic switching operation of valve 10 is accomplished by the fluid flow therethrough which causes the inner mechanism of the valve to route the fluid flow to each lateral in a predetermined sequence.

The switching rate of the valve is in direct proportion to the fluid flow rate, all of which will be hereinafter described in detail.

FIGS. 2, 3 and 4 illustrate one embodiment of the automatic flow switching valve of the present invention. Valve 10 comprises a housing 26 having an internal cavity 28 formed therein. The trunk line 14 is connected to inlet port 18 to supply fluid to the valve as hereinafter described. Inlet port 18 is in communication with the internal cavity 28. The outlet ports 20 are formed to radially extend from the housing 26 and are in communication with and extending from the internal cavity 28 to provide each outlet port 20. Each outlet port 20 may be rotated through a predetermined angular position by a rotatable disk 29 and is provided with a flow passage 32 formed therethrough. Flow passage 32 is substantially L-shaped and is provided with an inlet portion 34 which is in coaxial alignment with input port 18. Flow passage 32 is also provided with an outlet portion 36 which is positionable, as the rotor revolves, to move into coaxial alignment with each of the outlet ports 20.

A drive means is provided for supplying rotary motion to the rotor 30 and in this embodiment the drive means comprises a flow sensor means 38, a reduction means 46, and an intermittent motion device 50.

If time controlled switching of the valve 10 were desired, coupling a suitable electric motor (not shown) to the rotor would provide a drive means for the valve 10.

The flow sensor means 38 is mounted in the flow stream of the valve 10 to sense the flow rate therethrough. Flow sensor means 38 comprises an output shaft 40 which is mounted for rotation within the rotor 30. The output shaft 40 is provided with an impeller 42 mounted on the lower end thereof, which in this embodiment takes the form of a propeller which will rotate as the moving fluid contacts its blades 44. Rotation of the impeller 42 causes rotation of the output shaft 40 which is suitably coupled to provide the input to the reduction means 46. Reduction means may be any conventional gear train or similar device for taking a rotational input and providing a substantially reduced rate of rotational output.

Reduction means 46 is provided with an output shaft 48 which is coupled through the intermittent motion mechanism 50 to rotor 30 and will hereinafter be described in detail.

The combination of sensor means 38 and reduction means 46 will control the rotational rate of the rotor in direct proportion to the fluid flow rate through the valve. Therefore, variations in the fluid flow rate will cause similar variations in the rotational output of sensor means 38 which, being the input to the reduction means 46, will cause similar variations in the output rate thereof.

The intermittent motion device 50 comprises an output linkage 52 suitably mounted for rotation with output shaft 48 of reduction means 46. Linkage 52 carries on the outer end thereof a downwardly depending pin 54 which is suitably attached to the outer end of a coil spring 56. Coil spring 56 is coupled on the inner end thereof to a trunion 58 extending from rotor 30. Intermittent motion device 50 operates as a torsion storage device, that is, the rotational output of reduction means 46 will wind coil spring 56 through linkage 52 and pin 54, until the torque stored in the spring 56 is sufficient to overcome the inertia of rotor 30.

To augment the inertia of the rotor 30, and to properly index the rotor so that the flow passage 32 will be properly positioned in alignment with the output ports 20, there is provided a suitable spring-loaded friction applying means 60. Friction applying means 60 comprises a ball 62 which is biased by spring 64 into contact with the periphery of rotor 30. The rotor 30 is provided with a plurality of detents 66 formed in the periphery of the rotor and positioned thereon to align with the friction applying means 60. The detents 66 are spacedly arranged around the periphery of rotor 30 so that when the ball 62 engages each detent the rotor will stop in a position so that the outlet port 36 of passage 32 is in coaxial alignment with one of the outlet ports 20.

FIGS. 5, 6, 7, 8 and 9 illustrate another embodiment incorporating the features of the present invention. This embodiment comprises a valve 67 which employs a three-piece housing, an inlet housing 68, and outlet housings 70 and 72. Inlet housing 68 is provided with a suitable inlet port 74 and outlet housings 70 and 72 cooperate to provide a plurality of radially extending outlet ports 76. Although the outlet ports are shown as being radially disposed, it should be understood that this is merely a design expedient, as the ports 76 may be positioned to depend downwardly from housing 72.

A drive means is provided within the valve 67 and comprises a flow sensor means 84 and a reduction means 96 which cooperate to provide rotary motion to a rotor 102.

A central shaft 80 is fixedly held within the cavity 78 by suitable mounting bosses 82 provided in the housings 68, 70, and 72 for rotatably carrying the switching mechanisms as will hereinafter be described in detail.

The flow sensor means 84 is positioned within the upper portion of cavity 78 and is journalled for rotation about the fixed shaft 80. Flow sensor means 84 comprises an impeller wheel 86 having a disc-shaped upper portion 88 with a concentrically formed downwardly depending central hub 90. Depending downwardly from disc-shaped member 88 and extending radially from central hub 90 there is provided a plurality of spacedly arranged radially extending curved blades 92. The curved blades 92 are positioned to align with and be driven by the flow input through inlet port 74. Central hub 90 is provided with a pinion gear 94 suitably formed on the lower end thereof.

The reduction means 96, which is driven by pinion gear 94 of flow sensor means 84, may be any suitable reduction gear train 98 having part of the gears journaled for rotation on shaft 80 with the remaining gears being journalled for rotation on an offset shaft 100 suitably mounted in housing 70.

A disc-shaped rotor 102 is journaled for rotation about the fixed shaft 80 and is positioned within the lower portion of cavity 78. The disc-shaped rotor 102 is provided with a hub 104 concentrically formed on the disc and extending axially therefrom. A ring gear 106 is carried on the outer end of hub 104 and is posi-
tioned to be engaged and driven by an output gear 108 of reduction means 96. Disc-shaped rotor 102 is provided with a substantially pie-shaped void 110 formed therein, which provides the flow passage through the rotor.

As best seen in FIGS. 5, 6, 8 and 9, the housing 70 is provided with a plurality of substantially U-shaped radially disposed troughs 112, and the housing 72 is provided with similar troughs 113 formed therein. When housings 70 and 72 are assembled the troughs 112 and 113 are positioned so that each trough 112 is aligned with a trough 113 to form a plurality of vertically spaced apart pairs of troughs. As best seen in FIG. 8, each pair of troughs is in radial alignment with an outlet port 76. The troughs 113 are each provided with an upper bearing surface 114 which engages a lower surface 116 of the disc-shaped rotor 102. Troughs 112 are each provided with a lower bearing surface 118 which engages the upper surface 120 of the disc-shaped rotor 102. The bearing surfaces 114 and 118 of the troughs 112 and 113 circumscribe the openings to the troughs through which the fluid flow is directed to enter passages 122 which extend angularly from the troughs thus permitting fluid flow from the troughs to enter outlet ports 76.

Fluid flow entering through inlet port 74 flows into the lower portion of cavity 78 through a plurality of apertures 124 which are formed in housing 70 and spacedly arranged intermediate each of the troughs 112.

As seen best in FIG. 8, the fluid flow entering through apertures 124 into the lower portion of cavity 78 is allowed to pass through the pie-shaped void 110 formed in the rotor and enter into one pair of the troughs 112 and 113 and out through the appropriate outlet port 76.

As seen in FIGS. 6 and 9, the remainder of the aligned pairs of troughs are closed, therefore they will not conduct fluid to their associated outlet ports due to surfaces 116 and 120 of rotor 102 being in engagement with the surfaces 114 and 118 of the troughs.

It will be noted and best seen in FIGS. 5 and 6, that the pairs of troughs 112 and 113 do not extend into the center of the cavity 78, but instead leave a central well 125 both above and below the rotor 102. Therefore, fluid entering the lower portion of cavity 78 will flow intermediate the troughs above the rotor due to the apertures 124 and will also flow below the rotor by passing through void 110 into the central well 125 and from there will flow intermediate the troughs below the rotor. With the fluid being able to occupy corresponding areas above and below the rotor, a pressure balance is created which allows valve 67 to be employed in a high pressure system.

It should be noted that no pressure balance exists in the valve 10, thus valve 10 is best suited for low pressure operation.

As shown in the drawings and as hereinbefore described, valve 67 contains no intermittent motion device; however, a device similar to intermittent motion device 50 of valve 10 may be included in the design of valve 67. With no intermittent motion device, the rotor 102 will rotate slowly and continuously.

To provide a continuous flow through the valve 67 when on intermittent motion device is incorporated therein, the included angle between the sides 126 of the pie-shaped void 110 has been selected so that when the void 110 of the rotor 102 is intermediate two of the pairs of troughs, half of the fluid flow through the valve will be distributed to each of the adjacent troughs. This operational technique results in each lateral, as it is being serviced, receiving an increasing amount of fluid flow during the beginning of its servicing period and an extended time of full fluid flow, and decreasing flow during the end of its servicing period.

It should be noted that a continuous mode of operation of the valve 10 may be accomplished by elimination of the intermittent motion device 50 and the friction applying means 60, and coupling output shaft 48 of reduction means 46 directly to rotor 30 (not shown). Another modification (not shown) would be required to attain this mode of operation, this modification would involve a change in the configuration of the outlet portion 36 of flow passage 32. This change would require that the outlet passage 36, which is shown as a substantially tubular bore, would have to be modified to a pie-shaped configuration as hereinbefore described with reference to the void 110 in rotor 102 of valve 67.

FIG. 10 illustrates another embodiment of the invention. This embodiment incorporates a water inlet port 132 in cap 131 and a plurality of outlet ports 133 in base 130. An impeller 134, responsive to the inflow of water, operates through a reduction means in the form of a planetary gear train and a flapper valve 155 to sequentially distribute the flow of water to a plurality of laterals 12 (See FIG. 1) and through outlet ports 133. The design of the impeller 134 may be of any one of a number of well-known impeller designs. A design which has been found satisfactory is one incorporating a plurality of spiral flanges extending from a hub. To add rigidity and to maintain the flanges spaced apart from one another, one or more cross braces may extend across and be attached to the tops of the flanges.

An impeller 134 is mounted within cap 131 on axle 139. Axle 139 extends upwardly from the center of section 176 of base 130. The inlet port 132 includes a passegeway 138 for directing the water into cap 131. The orientation of the passegeway 138 is such that the incoming water is forced to tangentially strike the impeller 134. The flow of incoming water striking impeller 134 will tend to cause the impeller 134 to rotate.

A pinion gear 135 extends from the lower surface of impeller 134 and engages a first reduction gear 141. The first reduction gear 141 drives an output gear 145 via second, third, and fourth reduction gears 142, 143 and 144. Gear 145 operatively engages a ring gear 150, which is disposed about the inner periphery of base 130. The ratio of rotation between impeller 134 and gear 145 may be varied depending upon particular design requirements.

Gears 141 and 143 are mounted on a common axle 146, which extends from a boss 147 on a rotor 152. Gear 142 is mounted on axle 139 below a pinion gear 135. Axle 139 extends through a boss 140 on rotor 152. Gears 144 and 145 are mounted on their respective axles 148 and 149, which extend from rotor 152.

Gear 141 is retained on axle 146 by the lower surface of impeller 134 and by the upper surface of gear 143. Gear 142 is retained on axle 139 between the pinion gear 135 and boss 140. Gear 143 is retained on axle 146 between the pinion gear of gear 141 and the boss 147. Gear 144 is retained on axle 148 by the circular shroud 136 within cap 131 and the top surface of rotor 152. Gear 145 is retained on axle 149 by the circular
shroud 137 within cap 131 and the top surface of rotor 152.

Rotation of impeller 134 actuates the reduction means (gears 141, 142, 143, 144 and 145). The resultant rotation of gear 145 which is in direct engagement with ring gear 150 establishes a rotational force between axle 149 and ring gear 150. Because axle 149 is firmly attached to rotor 152, the rotor 152 rotates with respect to ring gear 150 either by a plurality of bolts or by a threaded arrangement. The base 130 further includes an annular cavity 161 having sides 173 and 174 extending upwardly from the bottom 182. A shoulder 178 extends along the outer edge of the bottom 182.

A central circular section 176 of base 130 includes a plurality of passageways 175 generally extending through section 176. One end of each of the passageways 175 terminates in one or more truncated, pie-shaped apertures 160 which are circumferentially disposed within the upper surface of section 176. The other ends of the passageways 175 respectively terminate in one of the outlet ports 133.

In this embodiment of the invention, two adjacent passageways 175, including the corresponding pairs of apertures 160, are provided with one of the outlet ports 133. A plurality of keys 156, each of which is radially aligned on section 176 and equidistant from its center, extend upwardly from section 176. Each key 156 separates one pair of apertures 160 from an adjacent pair of apertures 160.

A detailed description of the rotor 152 may be more easily set forth with reference to FIG. 12 taken in conjunction with FIG. 10.

The rotor 152 is rotatably mounted on axle 139 and is journaled by boss 140. Rotor 152 has two diametrically opposed and functionally distinct parts. The first part of rotor 152 consists of a generally triangular shaped part 183 having an arcuate outer edge, the radius of which is somewhat less than the radius of side 173 of the annular cavity 161. This triangular part 183 supports axle 146 via boss 147 and axles 148, 149. Triangular part 183 further includes a pair of elongated apertures 164, adjacent the periphery of the triangular part 183. The function of apertures 164 will be described in more detail below. The second part of rotor 152 is a generally rectangular shaped part 184. A flange 153 extends downwardly from the extremity of the rectangular part 184 and serves as a stabilizer in contacting a flapper valve 155 thereby preventing rotor 152 from tilting.

Referring to FIG. 13 in conjunction with FIG. 10, a resilient circular flapper valve 155 is mounted on base 130 adjacent the top surface of section 176 and below the rotor 152. The flapper valve 155 includes a centrally disposed aperture 168 for receiving a boss 167. A plurality of kerfs 165 extend inwardly from the periphery of the flapper valve 155 and divide the flapper valve 155 into a number of segments 185 corresponding to the number of outlet ports 133. Each of these segments 185 overlaps and covers one of the pairs of apertures 160 and acts as a valve for inhibiting a flow of fluid through the corresponding pair of apertures 160. The inner extremities of the kerfs 165 widen to form a plurality of elongated apertures 166. Each of these elongated apertures 166 is designed to permit one of the keys 156 to extend through the corresponding aperture 166 and the interlocking combination prevents rotation of the flapper valve 155 with respect to section 176.

The flapper valve 155 also includes a plurality of generally triangular shaped apertures 170, one of which is disposed within each of the segments of flapper valve 155. Apertures 170 do not overlie the respective pairs of apertures 160, but provide a flow path for the water when the respective pairs of apertures 160 are ported. Depending from the outer edge of each of the segments 185 of flapper valve 155 in a flange 157 as shown in FIG. 14. Flange 157 is defined by edges 171, 172 and 180. Edge 171 is angled at a relatively small angle with respect to vertical. Edge 172 is angled at approximately 45 degrees with respect to vertical. Edge 180 joins edges 171, 172 and is generally parallel to flapper valve 155.

A cam 154 travels within the annular cavity 161 in base 130 as shown in FIG. 11. The major axis of rectangular member 177 is curved in an arc having a radius approximately equal to the center line radius of annular cavity 161. Two keys 162 extend upwardly from the rectangular member 177 and engage the respective elongated apertures 164 of rotor 152. Any rotation of rotor 152 will cause the cam 154 to be correspondingly displaced about the annular cavity 161.

A pair of outer wheels 159 are journaled at the lower part of rectangular member 177. The wheels 159, which engage the shoulder 178 and supporting member 177 within the annular cavity 161, provide a very low friction movement of cam 154 with respect to the annular cavity 161.

A pair of inner wheels 158 are also journaled at the lower part of rectangular member 177, but on the inner side of rectangular member 177, as shown in FIG. 10. The vertical orientation of wheels 158 is selected to allow cam 154 to travel within annular cavity 161 while allowing wheels 158 to sequentially engage each of the flanges 157. Upon such engagement, the flange 157 will ride up on one of the wheels 158 causing the corresponding segment to bend upwardly and to uncover the respective pair of apertures 160. The rate at which the flange 157 is raised with respect to the distance traveled by cam 154 is a function of the slope of the corresponding edge of flange 157.

In this embodiment of the invention, the leading edge, or edge first contacting wheels 158, is edge 171. Referring to FIG. 14, edge 171 has a relatively steep slope and causes the flange 157 to move vertically upward more rapidly than the wheels 158 move horizontally. Edge 180 has essentially a zero slope and will not materially affect the vertical position of the raised flange 157 even though there is horizontal movement of the wheels 158. The trailing edge, or edge 172, has
a more shallow and reverse slope to that of edge 172. When wheels 158 engage edge 172, the flange 157 will move vertically downward at approximately the same rate as the wheels 158 move horizontally. With this arrangement of the leading and trailing edges, there will be an initial surge of water through an outlet port until a quiescent water flow is achieved followed by a gradual reduction of water flow. When neither of wheels 158 are in contact with a particular segment 183, the resilient material of the flapper valve 155 will cause that segment to contact and seal the corresponding pair of apertures 160. Two wheels 158 are used, rather than only one, to insure that at least one segment 185 of flapper valve 155 is raised at all times. Therefore, the distance between the journals or axles for wheels 158 is preferably unequal to the length of the chord of the arcuate edge of one of the segments 185. With this condition, it is impossible for one of the segments 185 not to be raised by one of the wheels 158. Were the wheels 158 to be separated by a distance equal to the chord of the arcuate edge of a segment 185, each of the wheels 158 would periodically be positioned adjacent the kefts 165 and between, but not contacting, the opposing edges 171, 172. In this position, all of the segments 185 would be adjacent to the corresponding pair of apertures 160 and serve to seal them, thereby inhibiting the flow of water through those apertures. Should there be no outflow of water, there can be no inflow of water, since cap 131 and base 130 define a closed system. Without an inflow of water, impeller 134 would cease to rotate and the water distribution system would stall.

The operation of this last embodiment of the invention may be summarized as follows: An inflow of water through inlet port 132 applies a force on impeller 134 causing the impeller 134 to rotate. The rotation of impeller 134, translated through the planetary gear train (including gears 141, 142, 143, 144 and 145 and ring gear 150), causes rotor 152 to rotate. The turning rotor 152, locked to cam 154 by keys 162 and extending through apertures 164, will displace cam 154 within the annular cavity 161. The displacement of cam 154 within the annular cavity 161 will sequentially raise and lower each of the segments 185 of flapper valve 155. This is achieved by the segmented engagement of wheels 158 with edges 171, 180 and 172 of flanges 157. The raising and lowering of the segments 182 of the flapper valve 155 will selectively port an outflow of water through the respective output ports 133 and into laterals 22.

I claim:

1. Apparatus for switching a fluid flow between an inlet port and selected ones of a plurality of outlet ports, said apparatus comprising in combination:
   an impeller disposed for angular rotation between the inlet port and the outlet ports and responsive to the fluid flow;
   a rotor disposed within said apparatus;
   a planetary gear train driven by said impeller for translating, at an reduced angular rate, the rotation of said impeller into the rotation of said rotor;
   a plate mounted within said apparatus, said plate having a plurality of independently movable segments, each of said segments being adjacent to a corresponding one of said plurality of outlet ports and being movable to selectively permit fluid flow between the inlet port and the selected outlet ports; and
   means responsive to said rotor for sequentially moving said segments from the outlet ports, whereby the fluid flow entering the apparatus through the inlet port is sequentially directed through each of the outlet ports.

2. The apparatus of claim 1 wherein said planetary gear train comprises:
   a plurality of axles extending from one side of said rotor;
   a plurality of gears journaled on said axles, each one of said plurality of gears including a pinion gear and said plurality of gears meshing to form a gear train;
   a ring gear disposed within said base; and
   an output gear journaled on one of said axles, said output gear jointly meshes with one of said plurality of gears and with said ring gear, whereby said rotor rotates with respect to said ring gear upon rotation of said impeller.

3. The apparatus of claim 2 wherein said plate comprises:
   a centrally apertured circular plate;
   a plurality of kerfs extending radially inwardly from the periphery of said plate, adjacent ones of said kerfs in combination with the corresponding peripheral edge of said plate defining segments of said plate; and
   a flange depending from the peripheral edge of each of said segments.

4. The apparatus of claim 1 wherein said plate comprises:
   a centrally apertured circular plate;
   a plurality of kerfs extending radially inwardly from the periphery of said plate, adjacent ones of said kerfs in combination with the corresponding peripheral edge of said plate defining segments of said plate; and
   a flange depending from the peripheral edge of each of said segments.

5. The apparatus of claim 4 including a base wherein said apparatus comprises an annular cavity disposed in said base for receiving said moving means.

6. The apparatus of claim 5 wherein said moving means comprises:
   a curved member, said curved member having a radius of curvature equivalent to the center line radius of said cavity;
   a first plurality of wheels attached to said curved member for maintaining said curved member above the bottom surface of said cavity; and
   a second plurality of wheels attached to said curved member for sequentially contacting the edges of each of said flanges, whereby said second plurality of wheels sequentially raises and lowers each of said segments as said curved member responds to said rotor.

7. The apparatus of claim 6 wherein said curved member includes a plurality of keys and said rotor includes a plurality of apertures for receiving said further plurality of keys, whereby said curved member is locked to said rotor for rotation therewith.

8. The apparatus of claim 7 wherein said flange includes three edges, said three edges comprising in combination:
a first edge disposed at a first angle with respect to the plane of said plate; a second edge disposed parallel to the plane of said plate; and a third edge disposed at a second angle with respect to the plane of said plate, whereby said second plurality of wheels on contacting said first and second edges raises and lowers said segments at differing rates.

9. The apparatus of claim 7 wherein the composition of said plate comprises resilient material, whereby said second plurality of wheels bends each of said segments.

10. The apparatus of claim 4 comprising: a further plurality of keys extending upwardly from the central part of said base, equal in number to the number of said kerfs; and an elongaged aperture extending inwardly from the inner extremity of each of said kerfs for receiving one of said further plurality of keys, whereby said plate is inhibited from rotational movement with respect to said base.

11. The apparatus of claim 10 wherein said plate includes a triangular aperture disposed within each of said segments, said triangular aperture being in a non-registering relationship with the corresponding outlet port.

12. The apparatus of claim 4 wherein the composition of said plate comprises resilient material whereby said moving means sequentially bends each of said segments.

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