United States Patent

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[54] **SPRINKLER SYSTEMS AND VARIABLE TIMING MEANS**
20 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **307/41,** 307/283, 307/301, 331/46
[51] **Int. Cl.** **H02j 3/14**
[50] **Field of Search** ..... 331/177, 178, 111 X, 52, 46 X, 48; 328/130, 131; 307/293, 283, 38, 39, 40, 41, 301

[56] **References Cited**

UNITED STATES PATENTS

3,392,350 7/1968 Griffin ..... 331/111 X

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ABSTRACT: A programming system involving automatic water sprinkling in which one of a plurality of resistances is automatically selected for insertion in the RC (resistance-capacitance) frequency-determining circuit of a relaxation oscillator. The oscillator after a time delay established by the selected resistance, causes a motor to rotate a plurality of selected switches, one of which selects a different resistance and another of which selects a different watering station. Manual override is provided. Means involving an On-Off-Repeat switch allows a selected watering station to correspondingly be (1) included once in the program, (2) excluded from the program or (3) included for a second time (repeat) without regard to particular time of day. Means are provided to prevent a watering operation at a station when the ground at that station is sufficiently moist.

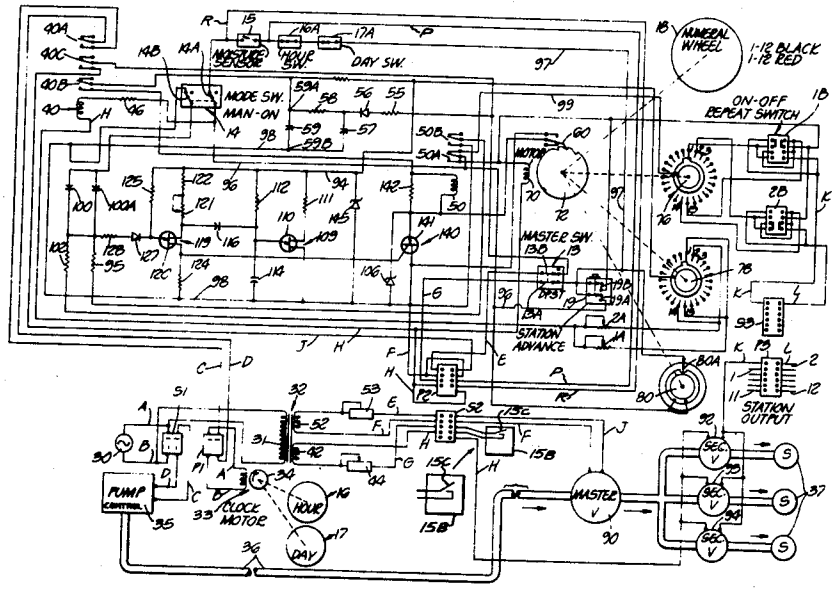
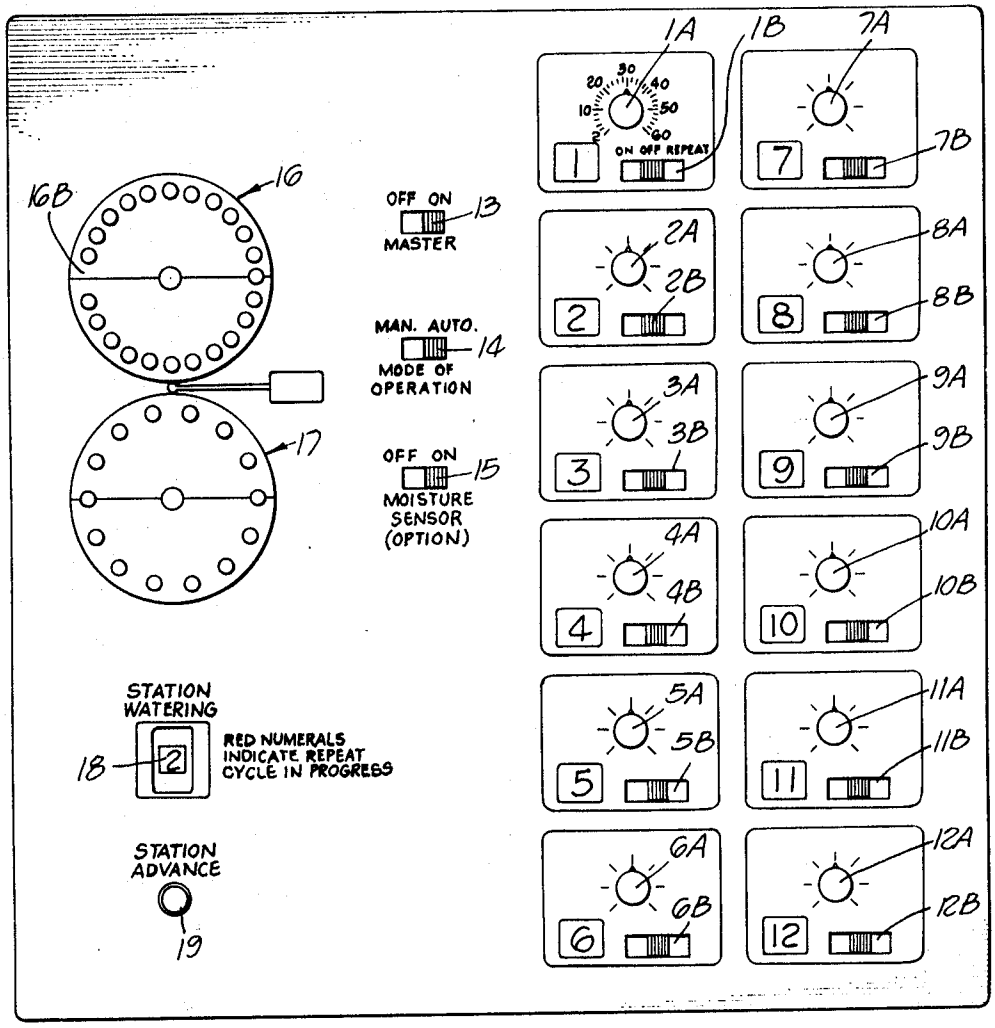


FIG. 1.



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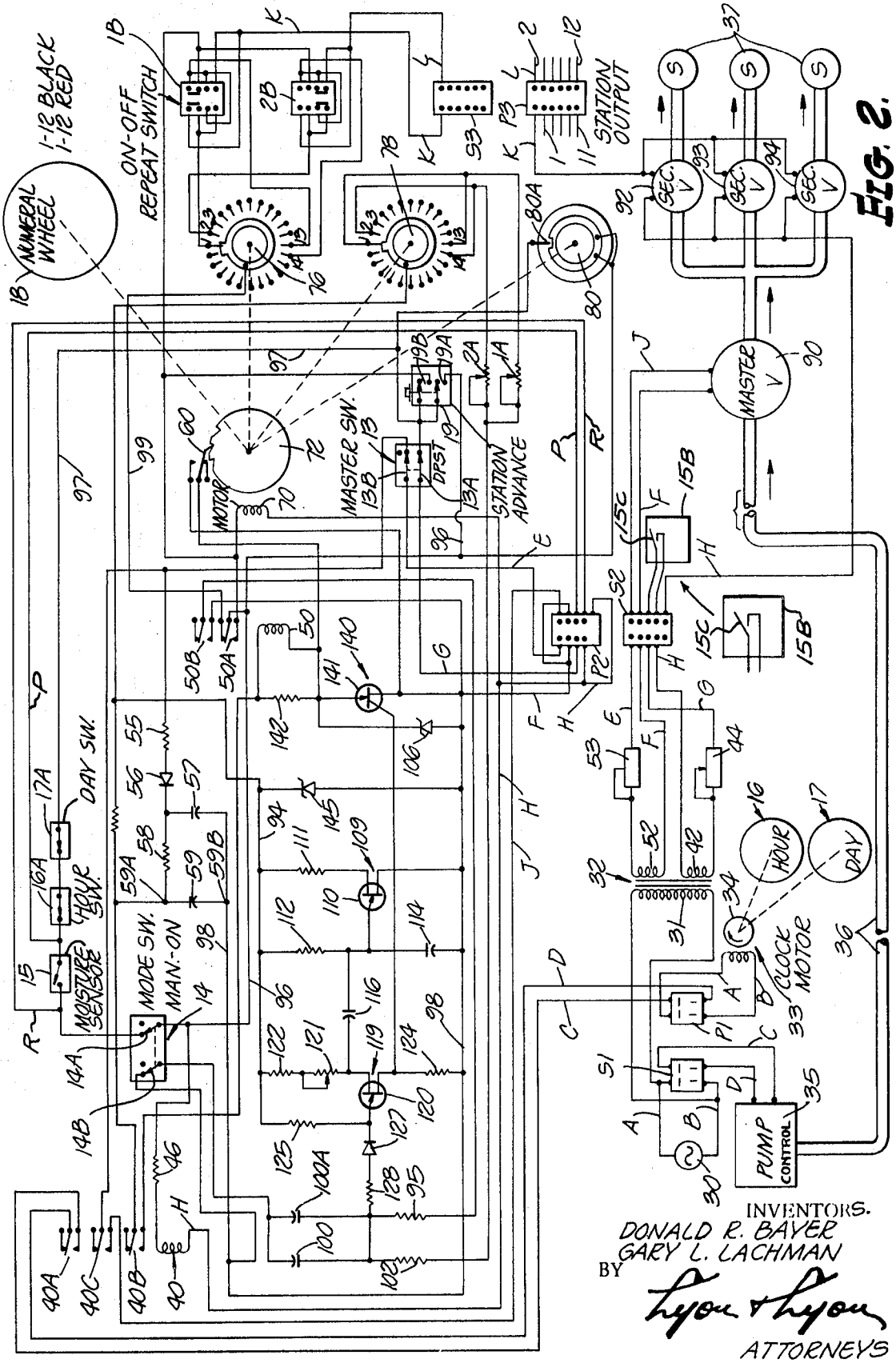

FIG. 2.

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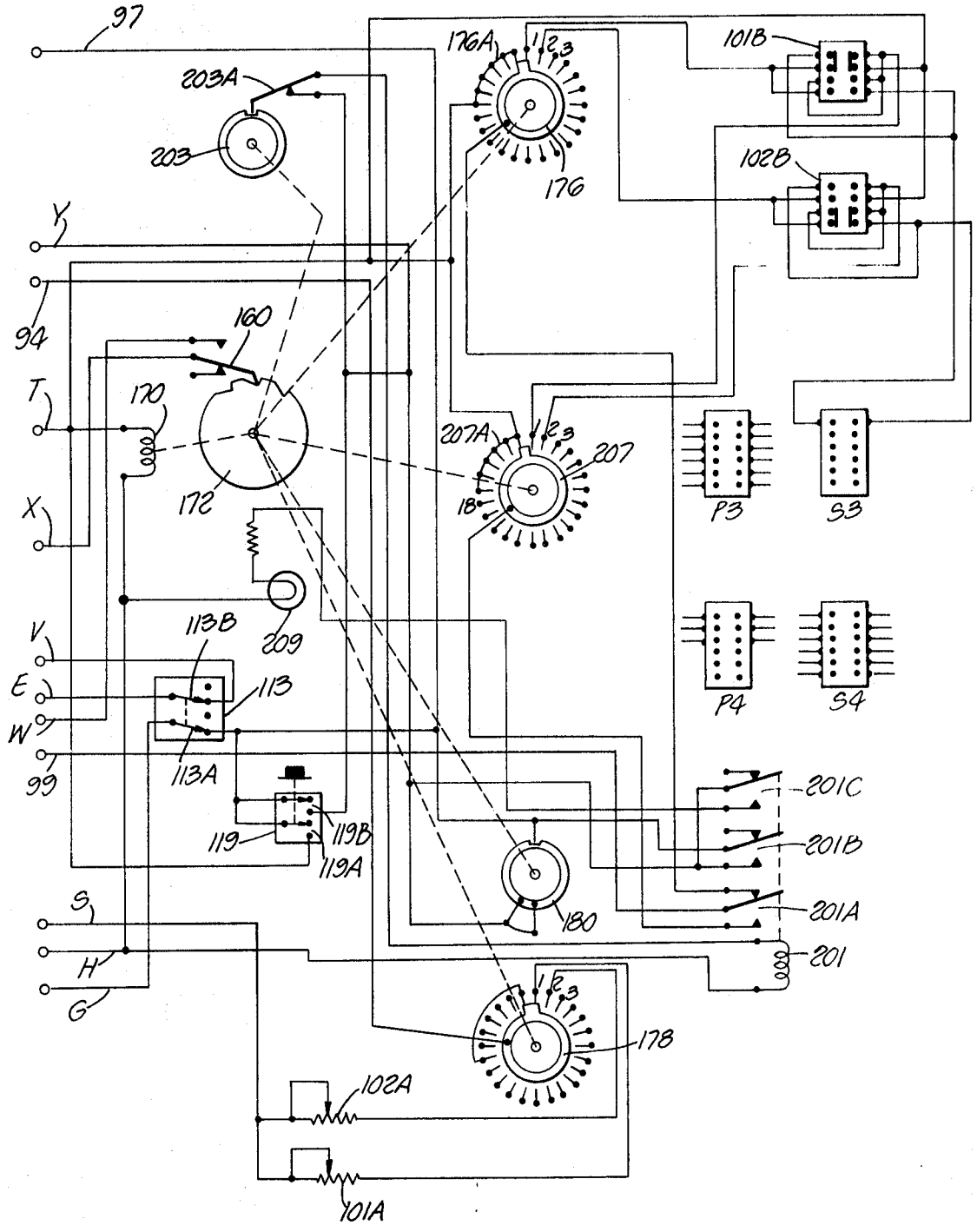

FIG. 3.

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SPRINKLER SYSTEMS AND VARIABLE TIMING MEANS

The present invention relates to improved means and techniques useful in time-controlled programs, particularly so in automatic water-sprinkling systems.

An object of the present invention is to provide an improved automatic water-sprinkling system in which the sprinkler valves at a plurality of stations or locations are selectively energized at various selectable times of the day within a 14 period and also with the duration of a sprinkling event being selectable and adjustable.

Another object of the present invention is to provide an improved sprinkling system of this character which is relatively simple, inexpensive, and foolproof in operation.

Another specific object of the present invention is to provide an improved sprinkling system in which the timing is effected, using characteristics of a capacitor-charging circuit.

Another specific object of the present invention is to provide a system of this character in which various stations may be selected for a repeat watering performance during a watering cycle and watering initiated without clock control, so as to have the advantage that the repeat performance may be accomplished immediately upon selection without the requirement of having to wait for a clock motor to operate a switch.

Another specific object of the present invention is to provide an improved water system incorporating means for preventing a watering operation at a particular station when the ground is sufficiently moist.

Another specific object of the present invention is to provide improved means and techniques whereby, for example, either one or more of 12 or of 18, or of 23 stations may be selected.

The features of the present invention, which are believed to be novel, are set forth with particularity in the appended claims. The invention itself, both as to its organization and manner of operation, together with other objects and advantages thereof, may be best understood by reference to the following description taken in connection with the accompanying drawings in which:

FIG. **1** illustrates an arrangement of controls on a panel of apparatus embodying features of the present invention.

FIG. **2** illustrates in schematic form the apparatus illustrated in FIG. **1** connected to a source of current and to solenoid valves for programming the flow of water to a corresponding watering station.

FIG. **3** illustrates a modified form of the invention.

While the description makes specific reference to a watering system, it will be appreciated that the invention in its broader aspects is applicable to programming systems generally, wherein means other than solenoid valves are relected and energized for selectable times.

Referred to FIG. **1**, the same shows a panel having mounted thereon various controls which are designated by corresponding numbers in FIG. **2**.

The discs **16** and **17** are driven by a clock motor **34** (FIG. **2**) such that the disc **17** makes 1 revolution per 2 weeks. The disc **16** includes **23** manually controllable switch elements **16A**, any one of which may be selected for performing a control function at a corresponding hour of the day. It is noted that there is one blank space at **16B**, and this corresponds to 6 a.m. in the morning, which is considered to be the start of the day for these particular purposes. The disc **17** likewise includes a series of manually controllable switch elements **17A**, any one of which may be selected to perform a control operation at the beginning of a corresponding day in a 2 interval. The switches **16A** and **17A** are indicated also in FIG. **2**.

The panel in FIG. **1** includes also an On-Off Switch **13**; a so-called mode of operation switch **14**, having a manual position and an automatic position; a moisture sensor switch **15** having an "off" position, and also an "on" position.

The panel in FIG. **1** includes means associated with each of the **12** different watering stations, and these stations are

designated also in FIG. **1** by the numerals **1–12**. A detailed description of the particular means at station **1** suffices also to describe like means at the other stations **2–2**. At station **1**, there is two manually operated elements, namely a knob **1A** and a three-position switch **1B**. Knob **1A** serves to adjust a resistor to establish a time interval or time delay extending from 2 to 60 minutes (1 hour), as indicated by the numerals **2–60**. The switch **1B** has an "on" position, an "off" position, and a "repeat" position.

The panel, FIG. **1**, includes also a momentary type pushbutton switch **19** for advancing the control to a different watering station. Also, the panel includes an apertured portion through which numerals on a numeral wheel **18** is visible, the particular numeral being an indication of the corresponding station which has been selected and which is in operation.

These controls and visual indicating means are clearly interrelated in the accompanying description of FIG. **2**, which now follows.

SOLENOID VALVE AND MOTOR OPERATION CIRCUITS

It is assumed that the three mating plug-and-socket connectors **P1**, **S1**; **P2**, **S2**; and **P3**, **S3** are engaged, in which case the wires designated by the same letter are interconnected. For example, when plug and socket **P1**, **P2** are engaged, plug wire A is connected to socket wire A; plug wire B is connected to socket wire B, etc.

In such case, it will be seen that the AC voltage source **30** is at all times connected to the primary winding **31** of the transformer **32** and also to the clock motor **33**, whose armature **34** drives the hour disc **16** and day disc **17** through suitable gearing such that hour disc **16** and day disc **17** through suitable gearing such that hour disc **16**, divided into **24** segments, rotates one complete revolution per 24 hours, i.e., per day, and that correspondingly, the day disc **17**, divided into 14 segments, rotates one revolution per 14 days, i.e., per 2 weeks.

In those instances where the system requires operation of a pump illustrated at **35** to pump water through pipe **36** to a sprinkler indicated at **37**, it is necessary to condition the pump control circuit for that purpose; and that is accomplished by energizing the pump start relay **40** through a circuit presently described. It will be seen that the lower terminal of relay coil **40** is connected to lead H, which extends through plug and socket **P2**, **S2**, to one terminal of secondary winding **42**, which has its other terminal connectable to the other terminal of relay coil **40** through a circuit which includes in this order: circuit breaker **44**, lead G extending through P2, S2; master switch **13A** in its closed position; day and hour microswitches **17A**, **16A** respectively operated upon rotation of corresponding day and hour discs **17**, **16**: moisture sensor switch **15** (which is jumpered or short circuited when no moisture sensor is being used in this particular system); mode of operation switch **14A** in its "Automatic" or "Auto" position illustrated in FIG. **2**; and dropping resistance **46** connected to such relay coil **40**. As illustrated, moisture sensing means **15A**, including in conventional manner a switch **15C**, is connected to leads P and R that extend to opposite terminals of the panel switch **15**. Switch **15C** is automatically closed when the moisture at a ground station is sufficiently high.

Relay coil **40**, when energized, causes three of its relay switches, **40A**, **40B**, and **40C**, to close. Closure of switch **40A** short circuits leads C and D, thereby conditioning the pump **35** for operation; closure of relay switch **40B** permits the rectified DC voltage to be applied to the other relay coil **50**, so as to be energized through a circuit which extends: from the upper terminal of secondary winding **52**, through circuit breaker **53**; connected leads E of P2, S2; through master switch **13B**; through dropping resistance **55** and rectifier **56** and output terminal **59A** of brute force filter circuit **57**, **58**, **59**, switch **40B**, and the upper terminal of the DC relay coil **50**. The other or lower terminal of such coil **50** is connected to the other output terminal **59B** through silicon controlled recti-

fier **140**, which is "fired" or rendered conductive after a controllable time delay, as explained later.

The other relay switch **40C** when closed serves to energize the master valve **90** by connecting such valve **90** to secondary winding **52** through a circuit which includes circuit breaker **53**, interconnected leads E, master power switch **13**, switch **40C**, valve **90**, and interconnected lead J of plug-socket P2, S2.

Thus, it will be seen when relay coil **40** is energized and silicon rectifier **140** conducts, the relay coil **50** is energized.

The normally closed section of relay switch **50A** serves to energize the station or zone solenoid valves **92, 93, 94** by applying that voltage which appears across the series connected relay coil **40** and resistor **46**, through the following path: via lead **96**, the movable arm of switch **50A**, the lead **99** which extends to the wiper arm of wafer switch **76**, through stationary contact **1** of switch **76**, through the On-Off-Repeat switch **1B**, and through the interconnected leads K of P2, S2 through the valves **92, 93**, and **94**, which are connected in parallel, and interconnected leads H to the other terminal of relay coil **40** across which the energizing voltage appears. Thus when silicon rectifier **140** remains nonconductive, i.e., relay coil **50** remains deenergized, the water control solenoids selected by switch **76** may be energized to cause water to flow.

The normally open relay switch **50B** is associated with the time delay circuit and is connected thereto as follows: The fixed contact of switch **50B** is connected to lead **98**, which may be considered to be at ground potential. The movable contact of switch **50B** is connected to one terminal of resistance **95**, having its other terminal connected to junction point **96** with one terminal of resistance **102, 128**, and capacitors **100, 100A**. The other terminal of each of capacitors **100, 100A** is connected via switch **14B** in its "Automatic" to the grounded lead **98** and the other terminal of resistance **102** being connected via resistance **1A** and wafer switch **78** to the voltage source lead **94**, so that in the deenergized condition of relay coil **50**, a charging circuit for capacitor **100, 100A** is established via resistance **102**, and in the energized condition of relay coil **50**, the precharged capacitor **100, 100A** may be discharged via resistor **95**.

Also, when such relay coil is energized, the movable contact of the single-pole, single-throw switch **50A** engages the lower stationary contact to energize the motor winding **70** for driving cam **72** and its associated numeral wheel **18**, selector switches **76, 78**, and end cycle switch **80**. The coil **50** is energized after a time delay established in the timing circuit or section.

THE TIMING SECTION

The timing section involves two unijunction transistor relaxation oscillators **109, 119** which are continuously energized by a rectified DC voltage which appears continuously between leads **94** and **98** when main power switch **13B** is closed. The basic operation of these relaxation oscillators involves the measurement of time by the charging of a capacitor through a resistance. (RC circuit). At the time the capacitor has charged to a predetermined voltage, the unijunction switches on. The turning on of the unijunction can be used to trigger other events as a result of a signal being generated. Also, the turning on of the unijunction transistor causes the timing capacitor to discharge through the base to emitter resistance of the transistor. The unijunction transistor then turns off and the capacitor again begins its charging cycle.

More specifically, the first relaxation oscillator **109** involves transistor **110**, resistances **111** and **112**, capacitor **114**, and coupling capacitor **116**. Transistor **110** is a 22646-type unijunction transistor. Resistance **112** and capacitor **114** connected between voltage leads **94** and **98** provide the RC timing circuit. Oscillator **109** functions to supply a ¾-volt negative pulse through capacitor **116** each time the transistor **110** is rendered conductive. This pulse enables the second relaxation oscillator **119** to obtain a long, 1-hour time delay when desired. The oscillation rate of the first oscillator **109**, measured in terms of its RC time, is preferably less than 0.02 times that of the second oscillator **119**.

The second oscillator **119** involves transistor **120**, resistances **121, 122, 124, 102, 95, 128**, diode **127**, and capacitors **100A, 100** and one of the adjustable 10 megohm panel control resistances **1A–12A** depending upon which of such resistances is switched in by wafer switch **78**. The ¾-volt negative pulse coupled to the second relaxation oscillator **119** via capacitor **116**, enables transistor **120** to fire on 1,000 times less current than would be required without this pulse. Transistor **120** is a 2N2647 transistor. The RC timing circuit is formed by the selected resistance **1A–12A**, resistance **102**, and capacitor **100A, 100**. Even though transistor **120** is turned off, there may be some leakage current flowing in the emitter of transistor **120**. As this back current is temperature dependent, it may vary at various times. To prevent this back current from causing timing inaccuracies by also charging capacitor **100, 100A**, a circuit including diode **127** and resistance **128** is provided. Resistor **125** provides bias for the diode **127**. Resistance **121** allows for temperature compensation and a trim pot adjustment to compensate for component tolerances in production. Resistor **124** has developed thereacross a voltage pulse, which is coupled to the silicon controlled rectifier (SCR) circuit **140** whenever transistor **120** is rendered conductive.

The SCR circuit **140** involves rectifier **141**, resistance **144**, and the relay coil **50**. When transistor **120** switches "On," it results in a voltage being developed across resistance **124**, which is coupled to the gate of rectifier **141**, which may be of the C6F type. When rectifier **141** fires as a result of this gate pulse, relay coil **50** is energized.

Once the rectifier is thus "fired," i.e., gated "on," it is turned off by reducing the anode voltage to 0 or by reducing the current flowing through the rectifier. Resistor **144** serves as a biasing resistor for rectifier **141**.

OPERATION

In operation, typically when the RC timing circuit of the second oscillator **119** has charged to the peak point firing potential of transistor **120**, it switches "On" and causes a gate pulse to be supplied to the rectifier **141**; and when it fires, relay coil **50** is energized. The relay switch **50A** is operated to remove valve voltage from the valve output wafer switches **76**, thereby providing some protection for the wafer contacts. This same set of relay contacts then supplies voltage to the station selector motor **70**, causing it to begin to drive. The index cam **72** rotates, causing the index microswitch **60** to close. This switch **60** parallels the rectifier **141** and reduces the rectifier current to 0 and thus turns the rectifier "Off." Also, such switch **60** maintains the relay coil **50** energized until the movable element of such indexing switch falls into the notch on the cam **72** associated with the next station. The relay switch **50B** provides an alternate discharge path for the timing capacitor of transistor **120** through resistor **95** to ground. This assures that the capacitor is discharged to the same point each time. The circuit is then ready to begin another timing cycle for the next station.

For these purposes, it will be seen that this motor winding **70**, when energized causes the modified disc or indexing cam **72** to rotate to cause the movable arm of switch **60** to ride up a ramp and contact its mating stationary contact. There are **24** such equally spaced ramps on the indexing cam **72**. In addition, the cam **72** has mechanically coupled thereto the 24-position numeral wheel **18**, the so-called valve and repeat wafer switch **76**, the so-called station timing selector switch **78** having 24 positions and also the so-called end cycle switch **80** which too have 24 angular positions established by the corresponding **24** ramps on indexing cam **72**. The indexing cam **72** and end cycle switch **80** are so oriented that when the switch arm **80A** is in the notch as shown in FIG. **2**, the arm of switch **60** is on the raised portion of the index cam **72** between positions **1** and **24**.

It will be seen that the On-Off-Repeat switches 1B, 2B, etc. are each independently adjustable and are each of the double-pole, triple-throw type. In the "on" position of, for example, switch 1B, watering at the corresponding watering station occurs when the movable arm of wafer switch 76 engages its number 1 stationary contact. However, if the controller is to cycle through a station, for example, station 1, its station selector switch 1B is set to the "off" or intermediate position, in which case it will be seen that the valve voltage is now switched from the valves 92–94 to the station selector Enercon motor winding 70 by that switch 1B in its assumed "off" position. Consequently, when this occurs, the wafer switch 76 does not stop at its number 1 position, but advances to its number 2 position, corresponding to watering station number 2, and stops at such number 2 position, providing however, that the On-Off-Repeat switch 2B is in its "on" position or in its "repeat" position. If switch 2B is in its "off" position, the motor winding 70 is again energized and the wafer switch 76 is advanced to its number 3 position. The motor 70 is deenergized only when the wafer switch 76 is advanced to a position wherein a correspondingly numbered On-Off-Repeat switch is either in its "on" position or in its "repeat" position. This so-called "repeat" position of any of the switches 1B–12B causes or allows watering at a repeat selected watering station to occur twice during one revolution of the end stop switch 80 prior to its movable contact 80A entering the notched insulated portion of the conductive ring portion of switch 80. Thus, as illustrated in FIG. 2, switch 2B in its repeat position supplies a valve voltage to lead L in either the number 2 position of wafer switch 76 or in its number 14 position. Thus, before one complete cycle is completed, i.e., before the wafer disc 80 makes one complete revolution two watering events occur at watering station number 2 when the wafer switch 76 is at rest in its number 2 and in its number 14 positions. However, only one watering event occurs at station 1 at which switch 1B is not in its repeat position but is in its "on" position.

The pushbutton switch 19 on the panel (FIG. 1) termed the "station advance" switch, when pressed causes its switches 19A and 19B to be closed. Switch 19A serves to short circuit a series comprising the time-controlled switches, the moisture sensor switch 15, as well as the mode switch 14A and to apply an energizing voltage directly to relay coil 40 from one terminal of the main power switch 13A. The other switch 19B serves to apply a voltage directly to the motor winding 70 from the from the same terminal of the main power switch 13A. Thus, the motor-driven cam 72 is advanced and continues to be advanced so long as the pushbutton switch 19 is operated. However, if there is only a momentary closure of switch 19A, 19B, sufficiently long to advance the motor to a point where the switch 80 is closed, the relay coil 40 continues to be energized even though switch 19A may be open. This is so because switches 19 and 80 are in parallel. Under this condition, since switch 19B is assumed to be reopened, energization of the motor is maintained by switch 60 which maintains energization of the DC relay winding 50 to energize motor 70. Switch 60 maintains energization of motor 70 until the movable arm of switch 60 falls on the next notch of cam 72, to reopen switch 60. Thereafter, after periodic time delays and subsequent stepping of the motor disc 72, the switch 80 is restored to its open position, and this corresponds to the end of the complete cycle. Once the end of the cycle is reached, i.e., the switch arm 80A enters the notched portion of the conductive ring portion of the switch 80, some positive action is required to short circuit or bypass switch 80. To start the next cycle, this is accomplished by operating either the station advance switch 19 or as a result of the day and hour switches 17A and 16A becoming closed (assuming in this latter instances that the mode switch 14A is in its automatic position and either switch 15 or switch 15B is closed).

In the automatic position of switch 14A, the control is, of course, sensitive to a particular day, a particular hour, as established by switches 17A and 16A, and also by the condition of the moisture sensor switch 15B, when used. When switch 15B is used, the watering cycle is prevented from being initiated in the event that the moisture content at the selected watering station is sufficient to have previously resulted in opening of switch 15B. However, once the watering at a station has been initiated, the condition of switch 15C is immaterial; because at that time, it is short circuited by switch 80.

Thus, it will be seen that the 14-"day" selector pins provide manual choice of watering schedules on every day, alternate days, or as seldom as once in fourteen days. Each such pin controls a 24-hour period, beginning at 6:00 a.m. The 23-"hour" selector pins provide manual choice of start of a watering cycle at any hour of the day or night (except 6:00 a.m.). Additional watering cycles may be initiated throughout the day at any hour after a previous cycle has been completed by adjustment of additional "hour" starting pins. Each station has an individual station selector switch to provide for programming the operation at that station. The "on" portion of switch 1B will result in watering during the automatic cycle only. The "off" position of that switch 1B results in that station being omitted from the automatic and repeat watering cycles. The "repeat" position results in watering during the automatic cycle and the repeat cycle. When the controller has completed the automatic watering cycle, the controller searches through the stations again and sequentially waters again those stations corresponding to those station switches that are in their "repeat" position.

MODIFICATION IN FIG. 3

The circuit previously described provides for 12 watering stations. The modification in FIG. 3 provides for a greater number of stations, for example, either a total of 18 stations or 23 stations, and involves the use of a latching relay and an additional cam-operated switch. For comparison purposes, elements in FIG. 3 corresponding to like elements in FIG. 2 have the same reference numeral, raised, however, by 100. New or additional elements in FIG. 3 are designated by reference numerals in the 200 series; and these include a latching relay, having an actuating coil 201 and associated relay switches 201A, 201B, and 201C, and a motor-driven cam 203, and associated microswitch 203A actuated thereby, and a motor driven 24-position wafer switch 207, and an indicating lamp 209. Further, in comparing FIGS. 2 and 3, it will be seen that the leads at the left in FIG. 3 are intended to be connected to circuitry having corresponding leads Y. 94, T, X, V, E, W, 99, S, H, and G in converting the 12 station control illustrated in FIG. 2, to the 18 station control illustrated in FIG. 3. Each of the wafer switches 176, 207, 178 are each of the make-before-break type and each have 24 positions. The index cam 172 has 24 positions as previously; and the cam 203 has only one notched portion within which the movable arm of switch 203A may enter to allow switch 203A to close, to thereby energize relay coil 201, which is then connected in a series circuit extending from lead H, through coil 201A, through switch 203A, through switch 180, through master power switch 113A, and lead G, it being also noted that the stationary contact of switch 203A is connected to lead Y. The switch 203A is operated once per revolution of motor 172, and this occurs in position 24, corresponding to position 24 of wafer switches 176, 207, 180, and 178.

Relay switch 201A has its movable switch arm connected to lead 99, and its lower stationary contact connected to the wiper arm of wafer switch 207, and its upper stationary contact connected to the wiper arm of wafer switch 176. The spaced stationary contacts 176, 207 are connected to corresponding On-Off-Repeat switches 101B, 102B, etc.

The relay switch 201B has its movable arm connected to one terminal of end stop switch 180 and also to lead G via master power switch 113, the stationary contact of switch 201B as well as the movable contact of switch 201C being connected to the other terminal of switch 180 and also to lead Y. The stationary contact of switch 201C is connected to one

terminal of indicating lamp 209, having its other terminal connected to lead H.

It will be seen from the foregoing, that when switch 203A closes, relay winding 201 is energized. This switch 203A is operated before switch 180 opens. When winding 201 is energized, the single-pole, double-throw switch 201A serves to transfer the voltage on lead 99 from wafer switch 176 to wafer switch 207. Closure of switch 201B results in in short circuiting of switch 180 to thereby prevent current from being interrupted. Closure of switch 201C causes light 209 to be lit, to thereby indicate a repeat function is being performed.

It will be observed that stationary contacts 19–24 of each of wafer switches 176 and 207 are interconnected by a corresponding jumper 178A, 207A so that the control as illustrated is intended to accommodate only 18 stations. For a maximum of 23 station operation, these jumpers are removed; and the stationary contacts then, unconnected, are each connected to a corresponding element at stations 19–23 respectively. Switch 178 is wired to assure continuous energization of the relaxation oscillators for increased stability and reproducibility.

During the automatic operation, the watering stations are selected by switch 176; but on the subsequent repeat operations, the watering stations are selected by switch 207. The particular stations that are effective, however, are established by the position of the corresponding On-Off-Repeat switch as previously discussed in connection with FIG. 2.

We claim:

1. In a programming system, a relaxation network involving a resistance-capacitance circuit which establishes the timing of said network; a plurality of adjustable resistances, one of which may be selected for insertion in said network to correspondingly establish the timing of said network; and switching means operated by said network in accordance with its timing for sequential selection and insertion of said adjustable resistances in said network.

2. A system as set forth in claim 1 wherein said network includes a pair of relaxation oscillators with the first of said oscillators serving in accordance with its timing to trigger the other of said oscillators, and a selected one of said adjustable resistances serves as a frequency determining element of said other oscillator, and the oscillation rate of the first oscillator is greatly higher than the oscillation rate of said other oscillator.

3. A system as set forth in claim 2 wherein each of said oscillators includes a unijunction transistor whose conductance is controlled by a resistance-capacitance circuit.

4. A system as set forth in claim 1 including a source of voltage; a plurality of devices, one of which is selected for energization by said switching means.

5. A system as set forth in claim 4 in which three-position switching means including an "On" position, an "Off" position, and a "Repeat" position is connected in series with a corresponding one of said devices, the first-mentioned switching means being sequentially operated from one step to a succeeding step; said three-position switch in its "On" position being effective to cause said first switching means to advance only one step and connect its corresponding series connected device; said three-position switch in its "Off" position being effective to prevent energization of its corresponding series connected device and to cause said switching means to advance to its next step; said three-position switch in its "Repeat" position being effective to cause said first switching means to advance only one step and connect its corresponding series connected device at two different times during stepping of said first switching means during one of its cycles of operation.

6. A system as set forth in claim 5 in which said sequentially operated switching means includes a motor for advancing associated step-by-step switching means.

7. A system as set forth in claim 5 in which said motor drives a switching device which makes one revolution per programming cycle.

8. A system as set forth in claim 5 in which said motor drives a switching device which makes a plurality of revolutions per programming cycle.

9. In a programming system of the character described, a source of voltage; a plurality of devices, one of which is selected for energization by said source; step-by-step switching means sequentially operated through a plurality of more than two steps during one cycle of operation a plurality of selector switch means having an "On" position, an "Off" position, and a "Repeat" position and being connected in series with a corresponding one of said devices; said selector switch in its "On" position being effective to connect said source to its corresponding device; said selector switch in its "Off" position being effective to prevent energization of its corresponding device; and said selector switch in its "Repeat" position being effective to connect said source to its corresponding device twice during one cycle of operation of said sequential operated switching means.

10. An arrangement as set forth in claim 9 wherein said sequentially operated switching means includes a motor-driven switching device that makes one revolution during each said cycle.

11. An arrangement as set forth in claim 10 in which said device makes more than said one revolution during each said cycle.

12. A system as set forth in claim 5 including time clock operated means effective to initiate one of said cycles of operation, said three-position switch in its "Repeat" position being effective to cause said sequentially operated switching means to advance only one step and connect said source to a corresponding series connected device at two different times during one cycle without requiring a second initiation by said time-clock-operated means.

13. A system as set forth in claim 9 including time-clock-operated means effective to initiate one of said cycles of operation, said three-position switch in its "Repeat" position being effective to cause said sequentially operated switching means to advance only one step and connect said source to a corresponding series-connected device at two different times during one cycle without requiring a second initiation by said time-clock-operated means.

14. In a programming system of the character described, a relaxation network producing output pulses; a plurality of means for adjusting the timing of said output pulses; and switching means receptive to and operated by said network in accordance with only one individual output pulse for sequential selection of said adjusting means such that each output pulse produces a selection and a different timing of the next succeeding output pulse.

15. In a system of the character described, a relaxation network including a timing circuit therefor which may be adjusted to adjust the periodicity of pulses produced by said network; sequentially operated switching means operable sequentially to different positions; switch-operating means connected to said network for operating said switching means to different ones of its sequential positions in accordance with each single pulse; and adjustable means connectable in said timing circuit by said switching means for adjusting the periodicity of each of said pulses and thereby said time duration.

16. In a system of the character described, a stepping device first switching means sequentially operated by said stepping device; a plurality of utilization devices one of which is selected by said first switching means; a relaxation network including a resistance-capacitance timing circuit; a plurality of adjustable resistances, one of which may be selected for insertion in said circuit to establish the timing of said network; second switching means sequentially operated by said stepping device and serving to connect a corresponding one of said resistances in said circuit; and of means responsive to each pulse produced by said network for advancing said stepping device and said first and second switching means one step.

17. A system as set forth in claim 16 including third switching means operated by said stepping device; said pulse responsive means including a controlled rectifier connected in series with a relay coil having an associated relay switch; said third switching means being shunt with said controlled rectifier; a source of voltage; and said relay switch serving to connect said source to said stepping device.

18. A system as set forth in claim 17 in which said relay switch is connected in a series circuit which includes said source and a time-controlled switch.

19. A system as set forth in claim 18 in which said series circuit includes also a moisture sensor switch.

20. A system as set forth in claim 18 in which another switch operated by said stepping device shunts said time-controlled switch.