

March 14, 1967

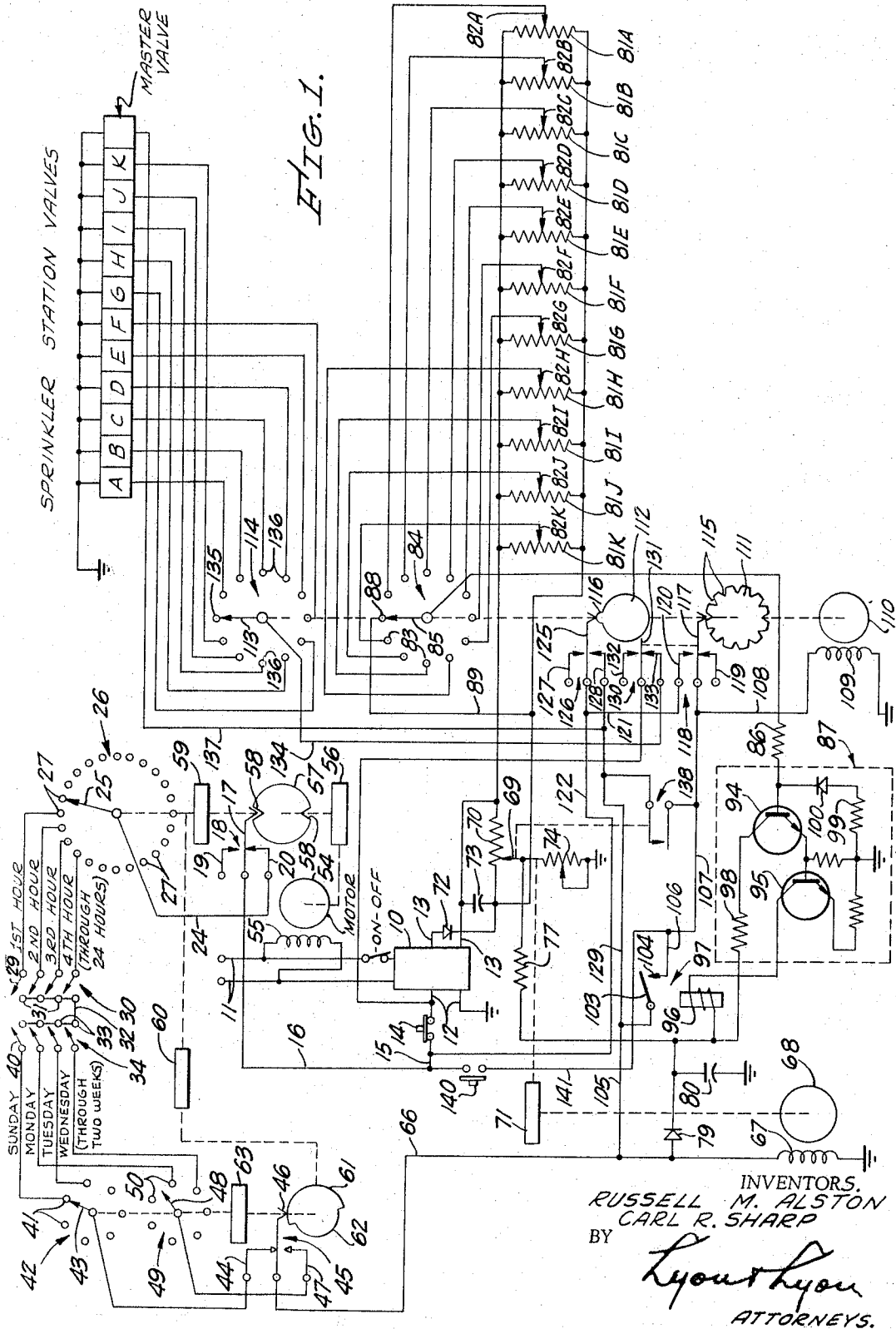
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AUTOMATIC CONTROL FOR SPRINKLER SYSTEMS

Filed July 22, 1963

2 Sheets-Sheet 1



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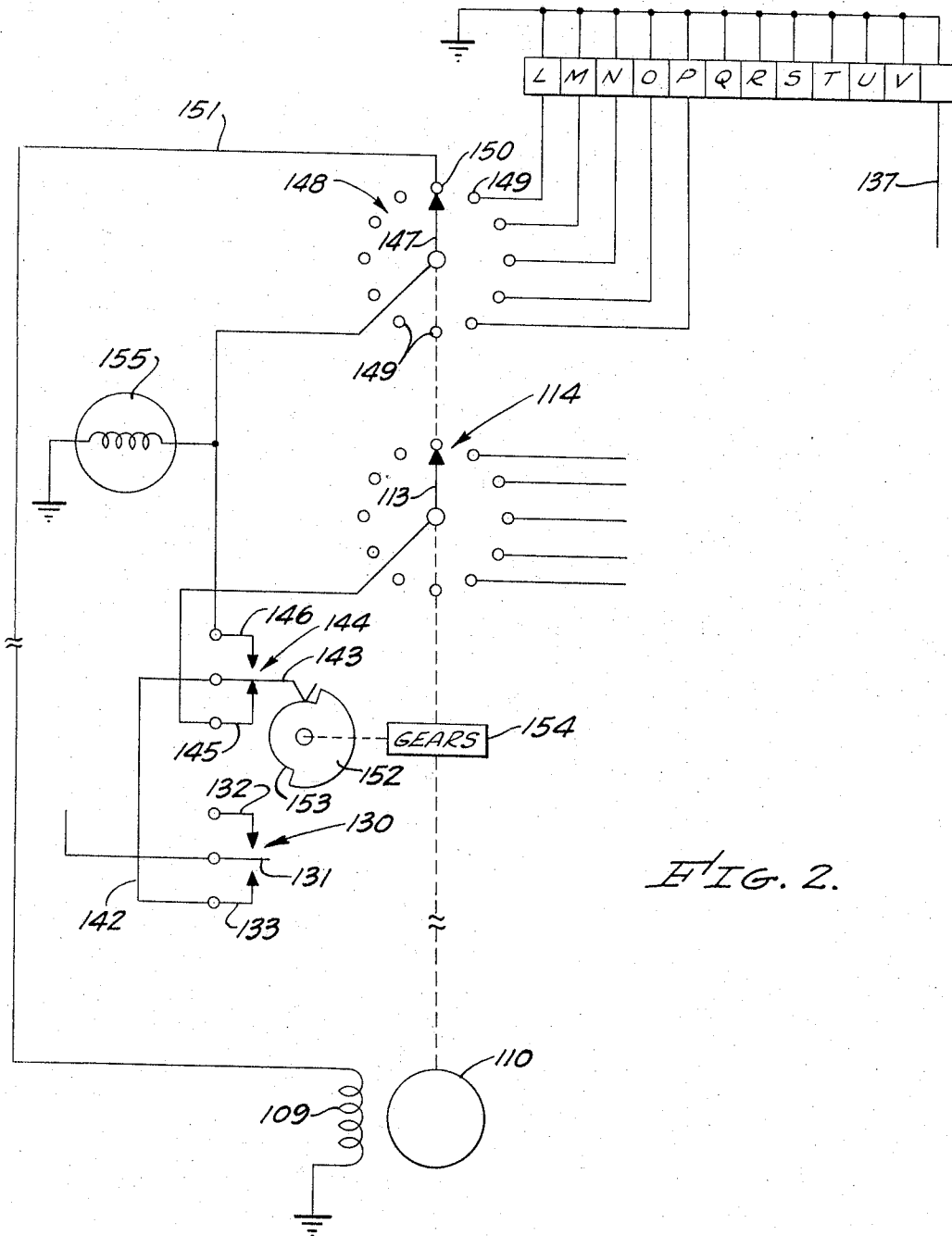
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AUTOMATIC CONTROL FOR SPRINKLER SYSTEMS

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Filed July 22, 1963, Ser. No. 296,844
12 Claims. (Cl. 307—141.4)

This invention relates to a system for controlling sprinkler operation and more particularly relates to such a system for controlling the day, hour and timing interval of operation of each of a plurality of sprinkler stations.

It is an object of the present invention to provide an electrical system for establishing the days and hours at which a plurality of sprinkling stations operate and the sprinkling interval of each sprinkling station.

It is also an object of the present invention to provide such a system in which easily set, serially connected switches determine the day and hour at which the entire sprinkling system is to operate and individual potentiometers determine the timing interval for each individual sprinkling station.

It is another object of the present invention to provide such a system in which the timing interval of each station is not affected by fluctuations in line voltage.

It is a further object of the present invention to provide such a system in which a transistor amplifier is used to sense the end of the timing interval of a station and initiate the operation of further apparatus which terminates the sprinkling action of that station and begins the sprinkling action of the next succeeding station.

These and other objects of the present invention will become more apparent upon reference to the accompanying description and drawings in which:

FIGURE 1 is a schematic diagram of the electrical control circuit of the present invention; and

FIGURE 2 is a schematic diagram of a modification of the control circuit of the present invention.

Briefly, this invention provides a system in which a pair of switch banks corresponding to hours of the day and days of the week are connected in series with a power supply to produce an output when a clock indicates that a selected hour and day have arrived. A bridge circuit made up of a master potentiometer and an adjustable potentiometer corresponding to one of the sprinkling stations produces an output signal indicative of the different settings of the respective potentiometer wiper arms, the wiper arm of the master potentiometer initially being in a zero voltage drop position. The output from the switching circuit energizes a motor which drives the master potentiometer arm until the bridge is balanced. A transistor amplifier senses this balance and energizes a motor which disconnects the first adjustable potentiometer from an effective position and connects another potentiometer corresponding to the next sprinkler station into the bridge circuit. The cycle is then repeated for each of a plurality of potentiometers corresponding to each of the sprinkler stations being controlled.

Referring now to the drawing, a power supply 10 has its input connected to standard 115 volt, 60 cycle power lines 11 and has a pair of outputs 12 and 13 for providing reduced voltages, for example 24 volts, to the control system. One side of output 12 is grounded and the other side is connected through a switch 14 and conductors 15 and 16 to the contact arm 17 of a switch 18, one stationary contact 19 of which is floating. The other stationary contact 20 of the switch 18 is connected by a conductor 24 to the wiper arm 25 of a rotary switch 26. The rotary switch 26 has twenty-four contacts 27, each contact corresponding to one hour of the day.

Each of the contacts 27 of the rotary switch 26 is con-

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nected to one of the contact arms 29 of a switch bank 30. All of the stationary contacts 31 of the switch bank 30 are connected to all of the contacts 33 of a second switch bank 34 by a common conductor 32.

The switch bank 34 has 14 individual switches, each of the switches corresponding to one of the days in a two-week period. The movable contact arm 40 of each alternate switch of the switch bank 34 is connected to one of the contacts 41 of a rotary switch 42. The wiper arm 43 of the rotary switch 42 is connected to one of the fixed contacts 44 of a switch 45 having a contact arm 46 and a second fixed contact 47 connected to the wiper arm 48 of a second rotary switch 49. Each of the contacts 50 of the rotary switch 49 is connected to one of the remaining contact arms 40 of the switch bank 34.

A clock motor 54 having an exciting winding 55 is driven at the rate of one revolution per hour. The output shaft of this motor is connected through gears 56 to a disk 57 that has a pair of cutouts 58 formed in the outer periphery thereof. The disk 57 cooperates with the contact arm 17 of the switch 18 and is driven at the rate of twelve revolutions per day so that once every hour the contact arm 17 is able to engage the contact 20 of the switch 18 for a period of time determined by the size of the cutouts 58.

The wiper arm 25 of the rotary switch 26 is also driven by the clock motor 54 through gears 59, the gearing ratio of the gears 59 being such that the wiper arm 25 is driven at the rate of one revolution per day. The output of gears 59 is also mechanically coupled through further gears 60 to a disk 61 which has a cutout surface 62 over half its periphery, and thence through gears 63 to the wiper arms 48 and 43 of the rotary switches 49 and 42. The gearing ratio of gears 60 and 63 is such that the disk 61 is driven at the rate of one-half revolution per day while the wiper arms 48 and 43 of the rotary switches 49 and 42 are driven at the rate of one revolution per two weeks.

The circuitry just described enables a pulse to be produced at any hour of any day over a two week period. The even number of days in the cycle permits the various sprinkling stations to be actuated on an alternate day basis if desired. As can be seen, the switch banks 30 and 34 are used to determine when the pulse is to be produced. If, for example, it is desired to actuate the sprinkler stations on the fourth hour of every alternate day, the contact arm 29 of the switch bank 30 corresponding to the fourth hour is manually closed as are the contact arms 40 of the switch bank 34 corresponding to Sunday, Tuesday, Thursday, Saturday, Monday, and so forth.

Assuming that it is Sunday of the first week, there will be an open circuit until the motor 54 drives the wiper arm 25 of the rotary switch 26 around to the contact corresponding to the fourth hour. As the wiper 25 engages this contact, the disk 57 will be in a position such that the contact arm 17 of the switch 18 moves into the cutout 58 thus permitting the contact arm 17 to engage the contact 20. A circuit is now completed through switch 14, conductor 15, conductor 16, contact arm 17, contact 20, conductor 24, wiper arm 25, switch 30, conductor 32, switch 34, contact 41, wiper arm 43 of rotary switch 42, contact 44 of switch 45 and contact arm 46 of the switch 45, resulting in an output pulse appearing on a conductor 66 connected to the contact arm 46.

The disk 61 has a configuration such that the contact arm 46 is kept in engagement with the contact 44 on every other day and in engagement with the contact 47 on the alternate days. The rotary switches 42 and 49 thus are connected into the circuit on alternate days of the two week period, the days on which their contacts 41 and

50 respectively are connected to the various switches of the switch bank 34.

Shortly after the output pulse is produced, the circuit is broken as the continued rotation of the disk 57 causes the contact arm 17 to ride up out of the contact 53 and disengage the contact 20.

The output pulse produced by this switching circuit is fed by the conductor 66 to the exciting winding 67 of the master potentiometer drive motor 68. The motor 68 drives the wiper arm 69 of a master potentiometer 70 through gears 71. The potentiometer 70 is connected across the output 13 of the power supply 10, a rectifier 72 and a filtering capacitor 73 being provided to rectify the output voltage. The wiper arm 69 is connected to ground through a variable resistor 74. The wiper arm 69 is also connected to the conductor 66 by means of a resistor 77, a rectifier 79, and a filtering capacitor 80. The resistors 77 and 74 thus act as a voltage divider to establish a potential on the wiper arm 69 which depends on the adjustment of the resistor 74.

A plurality of potentiometers 81A-81K are connected across the rectified and filtered output of the power supply 13 in parallel with the potentiometer 70. Each of the wiper arms 82A-82K of the potentiometers 81A-81K are connected to one of the contacts 83 of a rotary switch 84. These eleven potentiometers and their respective contacts correspond to the eleven sprinkler stations controlled by the present system. Any number of such stations can, of course, be controlled by varying the number of potentiometers and contacts. The wiper arm 85 of the rotary switch 84 is connected by a resistor 86 to the input of an amplifier indicated generally at 87.

As can be seen, the master potentiometer 70 and the potentiometers 81A-81K form a plurality of bridge circuits, each of which has an output appearing between the wiper arm 69 and one of the wiper arms 82A-82K. These outputs are sequentially sampled by means of the wiper arm 85 of the rotary switch 84. By setting the wiper arms of the potentiometers 81A-81K at various points, the sprinkler stations can be caused to be actuated for any desired time interval up to the maximum provided for by the master potentiometer. When the wiper arm of the selected potentiometer is, for example, set at its half way mark, the bridge will produce an output voltage which is the difference between the voltage on the wiper arm 69 which is initially positioned on the high voltage side of the potentiometer 70 and the voltage on the wiper arm of the selected potentiometer.

As the wiper arm 69 is driven across the potentiometer 70 by the motor 68, this difference voltage will decrease until the bridge is balanced, at which time the voltage appearing between the wiper arm of the selected potentiometer and the arm 69 will be equal to that appearing across resistor 74. It can thus be seen that by having the motor 68 take an hour to drive the arm 69 across the potentiometer 70, the time during which the bridge is unbalanced can be established at any interval up to an hour. In order that the bridge be balanced when the sprinkling cycle is initiated, the rotary switch 85 is provided with an extra contact 88 which is connected by a conductor 89 to the positive lead.

The amplifier 87 is conventional and comprises a pair of cascaded NPN transistors 94 and 95, the transistor 94 being connected as an emitter follower and having its base connected to the wiper arm 85 of the rotary switch 84 through the resistor 86. The output of the transistor 94 is connected to the input of the transistor 95, which transistor is connected to the conductor 66 through the rectifier 79 and the winding 96 of a relay 97. The collector of the transistor 94 is also connected to the conductor 66 through the rectifier 79 and a resistor 98. A resistor 99 and a diode 100 serve to prevent any substantial reverse current from flowing through the transistor 94, a condition which exists until the arm 69 of the potentiometer 70 is driven to the balance point causing the

reversal of the polarity of the output from the bridge circuit. Transistor 94 is biased by the potential appearing across resistor 74.

The transistor 94 is biased such that it will be in a nonconductive state when the bridge is unbalanced but will be switched to the conductive state when the bridge becomes balanced. Thus, when the arm 69 of the potentiometer 70 is driven to a position such that it balances the bridge, the transistor 94 will begin to conduct, causing the transistor 95 to conduct and a current to flow through the winding 96 of the relay 97.

Current flow through the winding 96 of the relay 97 will cause the armature 103 of the relay 97 to be drawn down into engagement with the contact 104, thus completing a circuit from the conductor 66, through the conductor 105, armature 103, contact 104, conductor 106, conductor 107 and conductor 108 to the exciting winding 109 of a motor 110. The motor 110 drives a first disk 111, a second disk 112, the wiper arm 85 of the rotary switch 84, and the wiper arm 113 of a rotary switch 114. The disk 111 has twelve notches 115 formed therein, each of the notches corresponding to one of the contacts 83 of the rotary switch 84. The disk 112 has a pip 116 formed thereon which is in the position shown when the wiper arm 85 of the rotary switch 84 engages the contact 88 thereof.

The disk 111 cooperates with the movable arm 117 of a switch 118 which has a first floating contact 119 and a second contact 120 connected by a conductor 121 and a conductor 112 to the switch 14. The movable arm 117 of the switch 118 is connected to the junction between the conductors 107 and 108.

The disk 112 cooperates with the movable arm 125 of a switch 126 which has a first floating contact 127 and a second contact 128 which is connected by a conductor 129 to the armature 103 of the relay 97.

A switch 130 has its moving arm 131 mechanically linked to the movable arm 117 of the switch 118. The switch 130 has a first floating contact 132 and a second contact 133 which is connected by a conductor 134 to the wiper arm 113 of the rotary switch 114. The rotary switch 114 has a first floating contact 135 and eleven other contacts 136, each of which is connected to a valve actuating device such as a solenoid which controls one of the sprinkler stations A-K. The contact 128 of the switch 126 is also connected by a conductor 137 to the valve actuator of the sprinkler system master valve. The other terminal of the solenoids or other valve actuating devices is grounded so as to complete the circuit.

A limit switch 138 is mechanically coupled to the arm 69 of the potentiometer 70 to form a short circuit between the conductor 129 and the conductor 107 in the eventuality that the arm 69 should for some reason be driven past the sixty minute position on the potentiometer 70.

In explaining the operation of the complete system, let it first be assumed that the clock motor 54 has driven the wiper arm 25 of the rotary switch 26 until it engages a contact 27 whose hour switch 29 and day switch 34 are closed so that a voltage appears on the conductor 66 and across the winding 67. Energization of the winding 67 results in the motor 68 beginning to rotate so as to drive the wiper arm 69 of the potentiometer 70. At this time, however, the voltage appearing on the wiper arm 85 of the rotary switch 84 is the balance voltage, that is, the voltage appearing at the junction between the resistor 77 and 74 as a result of the voltage appearing on the line 66. Since the transistor 94 is biased to conduct when this balance voltage is applied to its base, it immediately begins to conduct, causing conduction in the transistor 94 and a flow of current from the conductor 66 through the rectifier 79 and coil 96 of relay 97.

Energization of the winding 96 of the relay 97 causes the armature 103 to be drawn down into engagement with the contact 104, thus completing a circuit from the

conductor 66 through the conductor 105, armature 103, contact 104, conductor 106, conductor 107 and conductor 108 to the exciting winding 109 of the motor 110. The motor 110 now begins to rotate in the clockwise direction, driving the disk 111, disk 112, wiper arm 85 and wiper arm 113. As the disk 111 rotates, the end of the moving arm 117 of the switch 118 is driven up out of a notch 115 and engages the contact 120, thus completing a holding circuit to the winding 169 from the output 12, through the switch 14, the conductor 122, the conductor 121, contact 120, arm 117 and conductor 108. This holding circuit is necessary because the instant that the wiper arm 85 leaves the contact 83, the balance voltage is removed from the base of the transistor 94 and this transistor and the transistor 95 go uncondutive with the result that the relay winding 96 is de-energized and the relay contacts are opened, thus breaking the starting circuit of the motor 110.

As the disk 112 is rotated, the pip 116 moves away from under the arm 125 of the switch 126 with the result that this arm moves down and engages the contact 128, completing a circuit to the armature 103 of the relay 97 from the output 12, through the switch 14, the conductor 122, arm 125, contact 128 and conductor 129. This circuit is now used to supply the starting current to the motor 110 for the remainder of the sprinkling cycle. Immediately after this circuit is completed, the clock motor 54 has driven the disk 57 sufficiently to cause the end of the arm 17 of the switch 18 to move up out of the cutout 58 thus breaking the circuit through the hour and day switching system. The sprinkler control system is now completely independent of this switching system and remains so until all the sprinkling stations have been sequentially actuated.

This provision is made because the combined sprinkling intervals set on the potentiometers 81A-81K may be longer than the time during which the wiper arm 25 of the rotary switch 26 moves from one contact 27 having a closed switch 29 associated therewith to the next succeeding contact 27 having a closed switch 29 associated therewith. This system also permits the combined sprinkling time to be considerably less than one hour, a situation which is highly desirable for newly planted grass. The timing cooperation between the disks 57 and 112 is of course determined by the size of the cutouts 58 and the pip 116.

When the motor 110 has driven the disk 111 one-twelfth of a revolution, the end of the arm 117 again drops into one of the notches 115, breaking the circuit to the winding 109 and de-energizing the motor 110. At this time, the wiper arm 85 of the rotary switch 84 has engaged its first contact 83 and the wiper arm 113 of the rotary switch 114 has engaged its corresponding contact 136. Since the arm 117 is in its lower position, the arm 131 of the switch 130 is also in its lower position and is in engagement with the contact 133. As arm 131 is connected by a conductor 139 to the output 12 of the power supply 10, a circuit is completed through the conductor 139, arm 131, contact 133, conductor 134, wiper arm 113 and contact 136 to the valve actuating device of sprinkler station A. In the meantime, the master valve has been actuated through the switch 126 and conductor 137 so that the sprinklers making up sprinkler station A begin to sprinkle.

As soon as the wiper arm 85 of rotary switch 84 has engaged the first contact 83, the potentiometer 81A has been connected into the bridge circuit with the master potentiometer 70. Unless the potentiometer wiper arm 82A has been set at zero time, an unbalance exists and an unbalance voltage is fed to the base of the transistor 94 with the result that this transistor remains in its non-conducting state. The master potentiometer motor 68 now begins to drive the wiper 69 of the potentiometer 70, the circuit to the winding 67 of the motor being completed through the arm 125 and contact 128 of the

switch 126, the conductor 129 and the conductor 105.

As the arm 69 moves across the potentiometer 70, it eventually reaches the balance position and the voltage on the wiper arm 85 again becomes the balance voltage determined by the voltage divider 77-74. This voltage causes the transistors 94 and 95 to conduct, the relay coil 96 to be energized and the motor 110 again begins to rotate. As the wiper arm 85 leaves the contact 83, the balance voltage is removed from the base of the transistor 94 so the relay winding 96 is de-energized. The arm 117 has in the meantime been driven up out of the notch 115 and into engagement with the contact 120 so that the motor 112 continues to rotate to the next position. Movement of the arm 117 causes corresponding movement of the arm 131 with the result that the circuit to the valve actuator of sprinkler station A is broken and the valve closes causing sprinkling at this station to cease. Simultaneously, the wiper arm 69 of the potentiometer 70 is returned to the zero position in the manner set forth in our copending application filed concurrently herewith and entitled, "Cycling Mechanism for Sprinkler System Controllers."

This cycle continues, each potentiometer 81B through 81K being connected in turn into the bridge circuit, thus actuating its respective sprinkler station for the time interval set by the potentiometer wiper arms 82B-82K. After the last sprinkling station has been actuated, the motor 110 drives the disks 111 and 112 and the wiper arms 85 and 113 back to their initial position. At this time, the pip 116 in the disk 112 has moved the arm 125 away from the contact 128 thus breaking the main energizing circuit. The wiper arm 85 has been driven back into engagement with the contact 88 so the voltage appearing on the wiper arm 85 is the balance voltage and the transistors 94 and 95 are again ready to conduct when a voltage appears on the line 66. The wiper arm 113 is in engagement with the floating contact 135 of the rotary switch 114 so that none of the valve actuators are energized. The circuit to the master valve is also broken at the switch 116 so that this valve is also closed.

In the event that it is desired to skip one or more of the sprinkling stations without altering their respective potentiometers, the switch 140 is provided. Closure of the switch 140 completes a circuit from the output 12 of the power supply 10 through the switch 14, conductor 15, and a conductor 141 to the conductor 107 and then to the winding 109 of the motor 110. Closure of this switch 140 thus enables the motor 110 to be driven until the desired sprinkler station is reached.

FIGURE 2 illustrates a modification of the control circuitry which permits twice as many sprinkler stations to be controlled without increasing the number of potentiometers employed. In this figure, the same reference numerals are used to identify the same elements that appeared in FIGURE 1. In this modification, the contact 133 of the switch 130 is connected by a conductor 142 to the movable arm 143 of a switch 144. A first contact 145 of this switch is connected to the wiper arm 113 of the rotary switch 114. A second contact 146 of a switch 144 is connected to the wiper arm 147 of a rotary switch 148. The rotary switch 148 is similar to the rotary switch 114 and has eleven contacts 149, each of which is connected to a valve actuating device which controls one of the sprinkler stations L-V.

The rotary switch 148 has an additional contact 150 that is connected by a conductor 151 to the exciting winding 109 of the motor 110. A disk 152 having a cutout surface 153 over half its periphery is driven by the motor 110 through gears 154 at one half the speed of the motor 110. A lamp 155 is connected to the contact 146 of the switch 144 to indicate that the sprinkler stations L-V are being operated.

When the disk 152 is in the position shown, the wiper arm 113 of the rotary switch 114 is connected to the

contact 133 of the switch 130 and the system operates exactly as explained in connection with FIGURE 1. After the operating cycle of stations A-K is completed, the disks 111 and 112 and wiper arms 85 and 113 have reached the initial position as shown in FIGURE 1. In this position, however, the disk 152 has rotated to a position such that the movable arm 143 of the switch 144 is supported by the greater diameter portion of the disk 152 and consequently engages the contact 146 of the switch 144.

This contact is connected to the wiper arm 147 of the rotary switch 148, the wiper arm 147 being in engagement with the contact 150. A circuit is thus completed through the conductor 139, switch 130, conductor 142, switch 144, rotary switch 148, and conductor 157 to the exciting winding 109 of the motor 110. The motor 110 is therefore caused to drive to the rest position and the cycle is again completed, the potentiometers 81A-81K this time acting to control the sprinkling intervals of the sprinkler stations L-V. At the end of this cycle, the movable arm 143 of the switch 144 rides back down to the cutout portion 153 of the disk 152 with the result that all circuits to the winding 109 of motor 110 are broken and the system remains passive until the next signal appears on the conductor 66.

From the foregoing description, it can be seen that a control system has been provided for automatically actuating a plurality of sprinkler stations at any hour on any day. The system permits any desired watering cycle by providing a two-week rather than a one-week switching system. The watering interval of each sprinkling station can be easily adjusted without in any way bearing any of the other parts of the circuit. A transistor amplifier is used as the output device of a double potentiometer bridge circuit to insure rapid and dependable response to bridge balance. The use of the bridge as a timing circuit eliminates the possibility of fluctuations in line voltage affecting the timing interval of the sprinkler stations. By use of the modification of FIGURE 2, the number of stations controlled can be doubled with no increase in the number of potentiometers utilized.

The invention may be embodied in other specific forms not departing from the spirit or central characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

We claim:

1. A system for controlling a plurality of sprinkler stations comprising:

a power supply;

a motor;

means connecting said power supply with said motor to energize said motor, said connecting means including first switch means for permitting current flow through said connecting means at selected hours of the day and second switch means for permitting current flow through said connecting means on selected days of the week;

a master potentiometer connected to said power supply;

means drivingly connecting the wiper arm of said master potentiometer to said motor;

a plurality of adjustable potentiometers, each of said potentiometers corresponding to one of said sprinkler stations, said adjustable potentiometers being connected to said power supply to form a plurality of bridge circuits with said master potentiometer, the output of each bridge circuit appearing between the wiper arm of the master potentiometer and the wiper arm of the respective adjustable potentiometer;

a switch having a plurality of contacts and means for sequentially engaging said contacts, each of said contacts being connected to the wiper arm of one of said adjustable potentiometers;

a transistor amplifier having an input and an output, said input being connected to said sequentially engaging means of said switch;

a relay having a coil and a pair of contacts engageable by energization of said coil, said coil being connected in series with said output of said amplifier whereby it is energized upon conduction of said amplifier;

a second motor;

means drivingly connecting said second motor with said sequentially engaging means of said switch; and

means for connecting said motor to said power supply, said means including said contacts of said relay.

2. A system for controlling a plurality of sprinkler stations comprising:

a power supply;

a motor;

means connecting said power supply with said motor to energize said motor, said connecting means including first switch means for permitting current flow through said connecting means at selected hours of the day and second switch means for permitting current flow through said connecting means on selected days of the week;

a master potentiometer connected to said power supply; means drivingly connecting the wiper arm of said master potentiometer to said motor;

a plurality of adjustable potentiometers, each of said potentiometers corresponding to one of said sprinkler stations, said adjustable potentiometers being connected to said power supply to form a plurality of bridge circuits with said master potentiometer, the output of each bridge circuit appearing between the wiper arm of the master potentiometer and the wiper arm of the respective adjustable potentiometer;

a voltage divider having one end connected to said means connecting said power supply with said motor and the other end grounded;

means connecting the wiper arm of said master potentiometer to an intermediate point of said voltage divider;

a switch having a plurality of contacts and means for sequentially engaging said contacts, each of said contacts being connected to the wiper arm of one of said adjustable potentiometers;

a transistor amplifier having an emitter-collector circuit connected between said means connecting said power supply with said motor and ground;

means for connecting the base of said transistor to said sequentially engaging means of said switch;

a relay having a coil and a pair of contacts engageable by energization of said coil, said coil being connected in series with said emitter-collector circuit;

a second motor;

means drivingly connecting said second motor with said sequentially engaging means of said switch; and

means for connecting said motor to said power supply, said means including said contacts of said relay.

3. A system for controlling a plurality of sprinkler stations comprising:

a power supply;

a first switch having a plurality of contacts and means for sequentially engaging said contacts;

means for connecting said sequentially engaging means to said power supply;

a first plurality of switches each having a pair of relatively movable contacts, a first contact of each of said switches being connected to one of said contacts of said first switch;

a second plurality of switches each having a pair of relatively movable contacts;

means connecting each of said second contacts of said first plurality of switches with each of the first contacts of said second plurality of switches;
 a second switch having a plurality of contacts and means for sequentially engaging said contacts;
 the second contact of each of said second plurality of switches being connected to one of the contacts of said second switch;
 a motor including an exciting winding;
 means connecting said exciting winding to said sequentially engaging means of said second switch;
 a master potentiometer connected to said power supply;
 means drivingly connecting the wiper arm of said master potentiometer to said motor;
 a plurality of adjustable potentiometers, each of said potentiometers corresponding to one of said sprinkler stations, said adjustable potentiometers being connected to said power supply to form a plurality of bridge circuits with said master potentiometer, the output of each of said bridge circuits appearing between the wiper arm of the master potentiometer and the wiper arm of the respective adjustable potentiometer;
 a third switch having a plurality of contacts and means for sequentially engaging said contacts, each of said contacts being connected to the wiper arm of one of said adjustable potentiometers;
 a transistor amplifier having an input and an output, said input being connected to said sequentially engaging means of said third switch;
 a relay having a coil and a pair of contacts engageable by energization of said coil, said coil being connected to said output of said amplifier whereby it is energized upon conduction by said amplifier;
 a second motor including an exciting winding;
 means electrically connecting said exciting winding with one of said contacts of said relay;
 means connecting said other contact of said relay to said sequentially engaging means of said second switch; and
 means drivingly connecting said sequentially engaging means of said third switch to said second motor.

4. A system for controlling a plurality of sprinkler stations comprising:
 a power supply;
 a first switch having a plurality of contacts and means for sequentially engaging said contacts;
 means for connecting said sequentially engaging means to said power supply;
 a first plurality of switches each having a pair of relatively movable contacts, a first contact of each of said switches being connected to one of said contacts of said first switch;
 a second plurality of switches each having a pair of relatively movable contacts;
 means connecting each of said second contacts of said first plurality of switches with each of the first contacts of said second plurality of switches;
 a second switch having a plurality of contacts and means for sequentially engaging said contacts;
 the second contact of each of said second plurality of switches being connected to one of the contacts of said second switch;
 a motor including an exciting winding;
 means connecting said exciting winding to said sequentially engaging means of said second switch;
 a master potentiometer connected to said power supply;
 means drivingly connecting the wiper arm of said master potentiometer to said motor;
 a voltage divider having one end connected to said means connecting said exciting winding to said sequentially engaging means of said second switch;
 means connecting the wiper arm of said master potentiometer to an intermediate point on said voltage divider;

a plurality of adjustable potentiometers, each of said potentiometers corresponding to one of said sprinkler stations, said adjustable potentiometers being connected to said power supply to form a plurality of bridge circuits with said master potentiometer, the output of each of said bridge circuits appearing between the wiper arm of the master potentiometer and the wiper arm of the respective adjustable potentiometer;
 a transistor amplifier having an input and an output; means for sequentially coupling said amplifier input with the output of each of said bridge circuits; and means coupled to said amplifier and responsive to an output signal therefrom for actuating said sequentially coupling means.

5. A system for controlling a plurality of sprinkler stations comprising:
 a power supply;
 a first switch having a plurality of contacts and means for sequentially engaging said contacts;
 means for connecting said sequentially engaging means to said power supply;
 a first plurality of switches each having a pair of relatively movable contacts, a first contact of each of said switches being connected to one of said contacts of said first switch;
 a second plurality of switches each having a pair of relatively movable contacts;
 means connecting each of said second contacts of said first plurality of switches with each of the first contacts of said second plurality of switches;
 a second switch having a plurality of contacts and means for sequentially engaging said contacts;
 the second contact of each of said second plurality of switches being connected to one of the contacts of said second switch;
 a motor including an exciting winding;
 means connecting said exciting winding to said sequentially engaging means of said second switch;
 a master potentiometer connected to said power supply;
 means drivingly connecting the wiper arm of said master potentiometer to said motor;
 a voltage divider having one end connected to said means connecting said exciting winding to said sequentially engaging means of said second switch and the other end grounded;
 means connecting the wiper arm of said master potentiometer to an intermediate point on said voltage divider;
 a transistor amplifier having an input and an output;
 a plurality of adjustable potentiometers, each of said potentiometers corresponding to one of said sprinkler stations, said adjustable potentiometers being connected to said power supply to form a plurality of bridge circuits with said master potentiometer;
 means for sequentially coupling said amplifier input between the wiper arm of each of said adjustable potentiometers and ground, said amplifier being biased to conduct when a bridge balance signal appears at the input thereof; and
 means coupled to said amplifier and responsive to conduction thereof for actuating said sequentially coupling means.

6. A system for controlling a plurality of sprinkler stations comprising:
 a power supply;
 a first switch having a plurality of contacts and means for sequentially engaging said contacts;
 means for connecting said sequentially engaging means to said power supply;
 a first plurality of switches each having a pair of relatively movable contacts, a first contact of each of said switches being connected to one of said contacts of said first switch;

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a second plurality of switches each having a pair of relatively movable contacts;
 means connecting each of said second contacts of said first plurality of switches with each of the first contacts of said second plurality of switches;
 a second plurality of switches each having a pair of contacts and an arm for electrically connecting said contacts, the first contacts of said switches being electrically connected in series with the second contacts of said first plurality of switches;
 a third switch having a plurality of contacts and means for sequentially engaging said contacts;
 the second contact of each of said second plurality of switches being connected to one of the contacts of said third switch;
 a motor including an exciting winding;
 means connecting said exciting winding to said sequentially engaging means of said second switch;
 a master potentiometer connected to said power supply;
 means drivingly connecting the wiper arm of said master potentiometer to said motor;
 a plurality of adjustable potentiometers, each of said potentiometers corresponding to one of said sprinkler stations, said adjustable potentiometers being connected to said power supply to form a plurality of bridge circuits with said master potentiometer, the output of each of said bridge circuits appearing between the wiper arm of the master potentiometer and the wiper arm of the respective adjustable potentiometer;
 a second motor including an exciting winding;
 means for energizing said exciting winding of said second motor upon the balancing of one of said bridges;
 a fourth switch having a plurality of contacts and means for sequentially engaging said contacts, each of said contacts being connected to the wiper arm of one of said adjustable potentiometers, said sequentially engaging means being coupled to said energizing means;
 a fifth switch having a pair of relatively movable contacts;
 means electrically connecting said exciting winding of said second motor to one of said contacts of said fifth switch;
 means electrically connecting the other contact of said fifth switch to said power supply;
 means for periodically engaging said contacts of said fifth switch whereby a circuit is completed to the exciting winding of said second motor;
 means drivingly connecting said sequentially engaging means of said fourth switch and said means for periodically engaging said contacts of said fifth switch with said second motor, said connecting means causing said periodically engaging means to engage said contacts of said fifth switch while said sequentially engaging means of said fourth switch is unengaged with any of the contacts thereof; and
 a holding circuit for connecting said power supply with said exciting winding of said first motor during the time that said contacts of said fourth switch are being sequentially engaged.

7. A system for controlling a plurality of sprinkler stations comprising:
 a power supply;
 a first switch having a plurality of contacts and means for sequentially engaging said contacts;
 means for connecting said sequentially engaging means to said power supply;
 a first plurality of switches each having a pair of relatively movable contacts, a first contact of each of said switches being connected to one of said contacts of said first switch;

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a second plurality of switches each having a pair of relatively movable contacts;
 means connecting each of said second contacts of said first plurality of switches with each of the first contacts of said second plurality of switches;
 a second switch having a plurality of contacts and means for sequentially engaging said contacts;
 the second contact of each of said second plurality of switches being connected to one of the contacts of said second switch;
 a motor including an exciting winding;
 means connecting said exciting winding to said sequentially engaging means of said second switch;
 a master potentiometer connected to said power supply;
 means drivingly connecting the wiper arm of said master potentiometer to said motor;
 a plurality of adjustable potentiometers, each of said potentiometers corresponding to one of said sprinkler stations, said adjustable potentiometers being connected to said power supply to form a plurality of bridge circuits with said master potentiometer, the output of each of said bridge circuits appearing between the wiper arm of the master potentiometer and the wiper arm of the respective adjustable potentiometer;
 a third switch having a plurality of contacts and means for sequentially engaging said contacts, each of said contacts being connected to the wiper arm of one of said adjustable potentiometers;
 a transistor amplifier having an input and an output, said input being connected to said sequentially engaging means of said third switch;
 a relay having a coil and a pair of contacts engageable by energization of said coil, said coil being connected in series with said output of said amplifier whereby it is energized upon conduction by said amplifier;
 a second motor including an exciting winding;
 means electrically connecting said exciting winding with one of said contacts of said relay;
 means connecting said other contact of said relay to said sequentially engaging means of said second switch;
 a fourth switch having a pair of relatively movable contacts;
 means electrically connecting said exciting winding of said second motor to one of said contacts of said fourth switch;
 means electrically connecting the other contact of said fourth switch to said power supply;
 a fifth switch having a pair of relatively movable contacts;
 means connecting one of said contacts of said fifth switch to said power supply;
 means connecting the other contact of said fifth switch to said other contact of said relay;
 means for periodically engaging said contacts of said fourth switch;
 means for periodically disengaging said contacts of said fifth switch;
 a sixth switch having a plurality of contacts and means for sequentially engaging said contacts;
 a seventh switch having a pair of relatively movable contacts;
 means electrically connecting one of said contacts with said power supply;
 means electrically connecting the other of said contacts of said seventh switch with said sequentially engaging means of said sixth switch;
 means for periodically engaging said contacts of said seventh switch;
 means drivingly connecting said sequentially engaging means of said sixth switch, said sequentially engaging means of said third switch, said means for periodically engaging said contacts of said fourth switch,

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said means for periodically disengaging said contacts of said fifth switch and said means for periodically engaging said contacts of said seventh switch with said second motor; and

clock means drivingly connected to said sequentially engaging means of said first and second switches for sequentially engaging the contacts thereof.

8. A system for controlling a plurality of sprinkler stations comprising:

a power supply;

a motor;

means connecting said power supply with said motor to energize said motor, said connecting means including first switch means for permitting current flow through said connecting means at selected hours of the day and second switch means for permitting current flow through said connecting means on selected days of the week;

a master potentiometer connected to said power supply; means drivingly connecting the wiper arm of said master potentiometer to said motor;

a plurality of adjustable potentiometers, each of said potentiometers corresponding to at least one of said sprinkler stations, said adjustable potentiometers being connected to said power supply to form a plurality of bridge circuits with said master potentiometer, the output of each bridge circuit appearing between the wiper arm of the master potentiometer and the wiper arm of the respective adjustable potentiometer;

means responsive to the output of said bridge circuits for producing an output signal upon a balance thereof;

means coupled to said responsive means and to said bridge circuits for sequentially coupling the outputs of said bridges to said responsive means;

means coupled to said sequentially coupling means and said responsive means for advancing said coupling means to the next bridge circuit upon the balancing of the preceding bridge circuit;

first means for coupling each of a first portion of said sprinkler stations to said power supply whenever said sequentially coupling means is coupling the output of its respective bridge circuit to said responsive means;

second means for coupling each of a second portion of said sprinkler stations to said power supply whenever said sequentially coupling means is coupling the output of its respective bridge circuit to said responsive means; and

means coupled to said advancing means for actuating said second means after each of said first portion of stations has had the output of its respective bridge circuit coupled to said responsive means.

9. A system for controlling a plurality of sprinkler stations divided into first and second groups comprising:

a power supply;

a motor;

means connecting said power supply with said motor to energize said motor, said connecting means including first switch means for permitting current flow through said connecting means at selected hours of the day and second switch means for permitting current flow through said connecting means on selected days of the week;

a master potentiometer connected to said power supply; means drivingly connecting the wiper arm of said master potentiometer to said motor;

a plurality of adjustable potentiometers, each of said potentiometers corresponding to at least one of said sprinkler stations, said adjustable potentiometers being connected to said power supply to form a plurality of bridge circuits with said master potentiometer, the output of each bridge circuit appearing between the wiper arm of the master potentiometer and the

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wiper arm of the respective adjustable potentiometer;

means responsive to the output of said bridge circuits for producing an output signal upon a balance thereof;

a second motor;

means coupled to said responsive means for energizing said motor upon an output signal from said responsive means;

means coupled to said responsive means and said bridge circuits for sequentially coupling the outputs of said bridges to said responsive means;

means drivingly connecting said second motor to said sequentially coupling means for advancing said sequentially coupling means to the next bridge circuit upon energization of said motor;

a first switch having a plurality of contacts and means for sequentially engaging said contacts;

means coupling each of said contacts of said first switch to one of said sprinkler stations of said first group;

a second switch having a plurality of contacts and means for sequentially engaging said contacts;

means coupling each of said contacts of said second switch to one of said sprinkler stations of said second group;

a third switch having a pair of contacts and an arm movable into engagement with either of said contacts, one of said contacts being electrically connected to said sequentially engaging means of said first switch and the other of said contacts being electrically connected to the sequentially engaging means of said second switch;

means electrically connecting said movable arm to said power supply; and

means drivingly connected to said second motor and to said movable arm for alternately engaging said movable arm with said one contact and said other contact.

10. The system of claim 9 wherein said alternately engaging means comprises a disk with a portion having a lesser radius than the remainder of the disk.

11. A system for controlling a plurality of sprinkler stations divided into first and second groups comprising:

a power supply;

a first switch having a plurality of contacts and means for sequentially engaging said contacts;

means for connecting said sequentially engaging means to said power supply;

a first plurality of switches each having a pair of relatively movable contacts, a first contact of each of said switches being connected to one of said contacts of said first switch;

a second plurality of switches each having a pair of relatively movable contacts;

means connecting each of said second contacts of said first plurality of switches with each of the first contacts of said second plurality of switches;

a second switch having a plurality of contacts and means for sequentially engaging said contacts;

the second contact of each of said second plurality of switches being connected to one of the contacts of said second switch;

a motor including an exciting winding;

means connecting said exciting winding to said sequentially engaging means of said second switch;

a master potentiometer connected to said power supply; means drivingly connecting the wiper arm of said master potentiometer to said motor;

a plurality of adjustable potentiometers, each of said potentiometers corresponding to at least one of said sprinkler stations, said adjustable potentiometers being connected to said power supply to form a plurality of bridge circuits with said master potentiometer, the output of each of said bridge circuits appearing between the wiper arm of the master po-

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tentiometer and the wiper arm of the respective adjustable potentiometer;
 a third switch having a plurality of contacts and means for sequentially engaging said contacts, each of said contacts being connected to the wiper arm of one of said adjustable potentiometers;
 a transistor amplifier having an input and an output, said input being connected to said sequentially engaging means of said third switch;
 a relay having a coil and a pair of contacts engageable by energization of said coil, said coil being connected to said output of said amplifier whereby it is energized upon conduction by said amplifier;
 a second motor including an exciting winding;
 means electrically connecting said exciting winding with one of said contacts of said relay;
 means connecting said other contact of said relay to said sequentially engaging means of said second switch;
 means drivingly connecting said sequentially engaging means of said third switch to said second motor;
 a fourth switch having a plurality of contacts and means for sequentially engaging said contacts;
 means coupling each of said contacts of said fourth switch to one of said sprinkler stations of said first group;
 a fifth switch having a plurality of contacts and means for sequentially engaging said contacts;
 means coupling each of said contacts of said fifth switch to one of said sprinkler stations of said second group;

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a sixth switch having a pair of contacts and an arm movable into engagement with either of said contacts, one of said contacts being electrically connected to said sequentially engaging means of said fourth switch and the other of said contacts being electrically connected to the sequentially engaging means of said fifth switch;
 means electrically connecting said movable arm to said power supply, said means including a seventh switch;
 means drivingly connected to said second motor and to said movable arm for alternately engaging said movable arm with said one contact and said other contact; and
 means drivingly connected to said second motor for closing said seventh switch when the sequentially engaging means of either said fourth switch or said fifth switch is in engagement with one of the contacts thereof.
 12. The system of claim 11 wherein said alternately engaging means comprises a disk with a portion having a lesser radius than the remainder of the disk.

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