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TIMER

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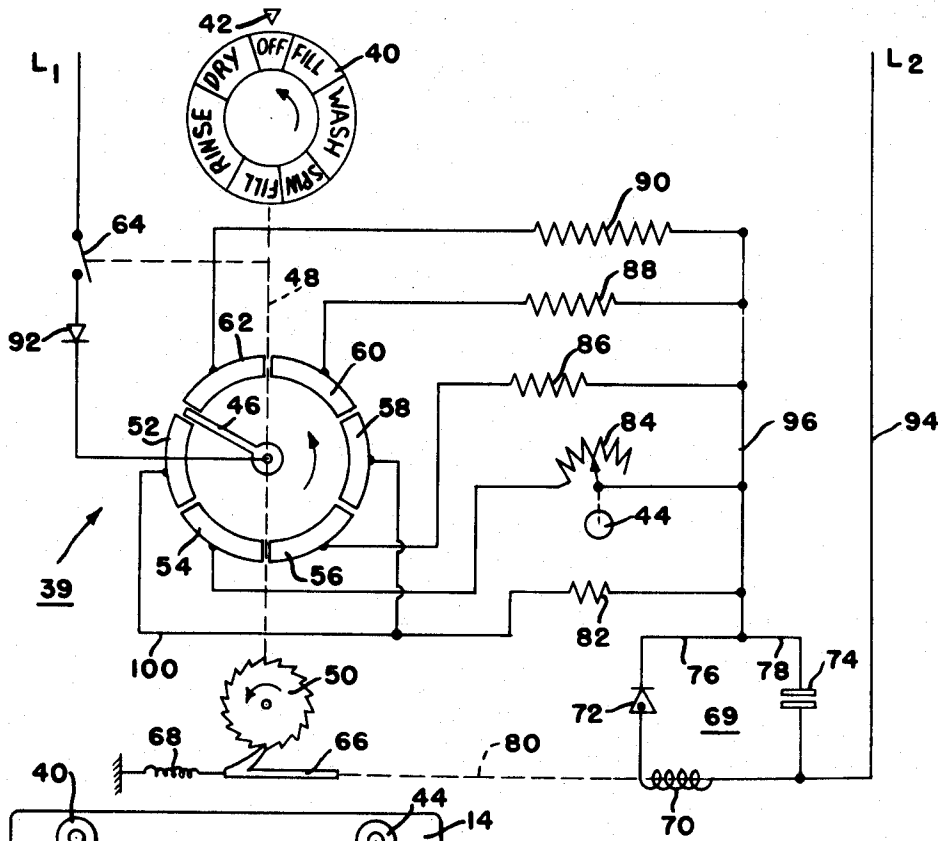


Fig. 2

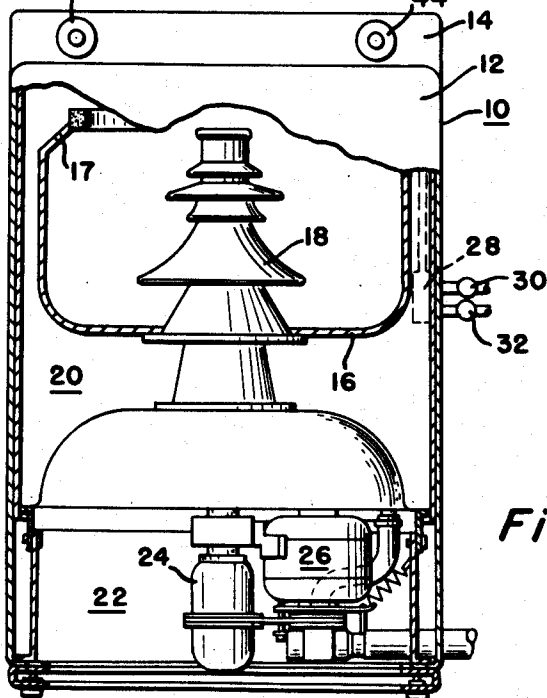


Fig. 1

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3,171,045
TIMER

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This invention relates to a domestic appliance and more particularly to an appliance timer with means for selectively altering the timing impulses.

The advance of the automatic appliance art has found the cycles for such appliances becoming more and more complex. Since the automatic operation of such appliances is controlled by timers, these timers, in turn, have become more involved and cumbersome. In the washing machine art, for instance, the washer has been modified to give the operator an infinite variety of controls for her washing procedures. The amount of water fill is made variable by a separate control. The duration of the wash or agitate portion of the cycle is made variable by a separate control and the duration of various dispensing operations have been made variable by separate controls. In some timers these separate controls have been manifolded into a single switch which is presettable in accordance with the fabric being washed. Nevertheless, the automatic timers in use today incorporate a great number of separate switch contacts for the various control circuits as well as speed changing mechanisms which advance the timer either slow or fast depending upon whether the duration of a cycle portion is to be long or short respectively. One such timer in use today is taught in the patent to Sisson, 2,870,834, issued January 27, 1959. Such prior art timers have become unduly complicated and servicing thereof has become a considerable problem.

Accordingly, it is an object of this invention to provide an automatic appliance timer which is extremely accurate as well as simple to construct and operate.

A further object of this invention is the provision of a sequential timing device actuated by a solenoid which is periodically energized through a transistor diode timing circuit.

Generally, it is an object of this invention to provide an electrical timer for controlling a plurality of operations, said timer having means to selectively alter the timing impulses to vary independently the length of the various operations.

More specifically, it is an object of this invention to place a transistor diode timing circuit selectively in series with one of a plurality of different resistances to predetermine the duration of that portion of a timing cycle with which the resistance is associated.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein preferred embodiments of the present invention are clearly shown.

In the drawings:

FIGURE 1 is a sectional view partly in elevation of a clothes washing machine suitable for use with this invention; and

FIGURE 2 is a schematic wiring diagram of this invention.

In accordance with this invention and with reference to FIGURE 1 a clothes washer 10 is illustrated. The clothes washer 10 includes a cabinet or casing 12 having a control housing or console 14. The cabinet 12 encloses a rotatably mounted spin basket or tub 16 in which is disposed a vertically reciprocable agitator 18. The casing 12 is divided into a water container compartment 20 and a machinery compartment 22 in which is dis-

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posed an agitate and spin mechanism 24 for selectively rotating said spin basket 16 and reciprocating said agitator 18. For selectively rotating the agitate and spin mechanism 24 a reversible prime mover or motor 26 is included.

Water may be supplied to the interior of the spin tub 16 through a mixing valve 28. Supplying the mixing valve 28 is a solenoid actuated hot water supply valve 30 and a solenoid actuated cold water supply valve 32. The valves 30 and 32 are controlled so that the amount of fill supplied to the tub 16 is determined by the length of time that the valves 30 and 32 are energized.

During a washing cycle in the above described clothes washer 10, it is desirable to provide certain portions of the cycle which operate for longer periods than other portions of the cycle. In addition, it is desirable to include a variable wash or agitate period in an appliance. In this latter instance the machine is controlled to agitate for brief periods clothing which is only slightly soiled and to agitate for extended periods clothing which is particularly soiled. Similarly, a centrifuging operation follows which requires less time than a wash agitation to eliminate the soiled wash water from the tub through the outflow ports 17. In other words each period of fill, agitate and spin throughout the washing cycle may be of a different duration.

In conventional timers cams are used in which the lobes are designed to complete a circuit for a predetermined period of time. In such timers many cams are required for the various circuits involved and an escapement mechanism is included in conjunction with a synchronous motor, thereby pulsingly to advance the timing device throughout the washing cycle. Accordingly, it is an object of this invention to eliminate the requirement for a motor operated timer, the need for a plurality of differently time configured cams, and to eliminate the need for an expensive escapement mechanism. These and other objects are accomplished in a timer which is extremely simple as well as more sensitive to secure the exact timed periods required for the various different washing operations.

For controlling the duration of the various operations of the clothes washer 10 a timing device 39 shown schematically in FIGURE 2 is utilized. The timer 39 of this invention includes a control knob 40 on one side of console 14 of the washer, said control knob being provided with indicia for programming the advance of the washing cycle. The progress of the washing cycle may be indicated by the rotation of the knob 40 past an indicator 42. On the opposite side of the washer console 14 is a wash or agitate duration knob 44. In accordance with the positioning of the knob 44 the length of the wash agitation period may be lengthened or shortened.

The washing cycle is advanced by the rotation of a timer switch blade 46 which is carried by a timer shaft 48. At one end of the timer shaft 48 is the cycle control knob 40 while at the opposite end of the timer shaft is a ratchet wheel 50 for intermittently and pulsatingly rotating the timer shaft 48 and, thus, the timer switch blade 46. Disposed about the timer switch blade 46 are a plurality of electrically conducting washing cycle segments or stations. It should be understood that the timer switch blade 46 determines the length of time during which each of the various cycle functions is pursued. Other circuits (not shown) will energize the particular washer components involved for the regulated time interval—cams for this purpose being carried by the timer shaft 48 in a manner similar to the cams and circuits taught in the cited patent to Sisson, No. 2,870,834. In other words the timer switch blade 46 and its associated contacts 52, 54, 56, 58, 60 and 62

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replace the motor and escapement mechanism of the Sisson patent. More particularly, a washing cycle is initiated through a fill cycle segment 52 during which the fill valves 30 and 32 are selectively energized by other cam actuated circuits to supply water to the spin tub 16. Next, a wash cycle segment 54 may be engaged by the timer switch blade 46 to regulate the length of time during which a wash agitation cam (not shown) will cause a circuit to energize the motor 26 to vertically reciprocate the agitator 18. Next, a wash spin cycle segment 56 is selectively engageable by the timer switch blade 46 to control the duration of time when the motor 26 is energized in reverse fashion to spin the tub 16 as a means to centrifuge the soiled wash water from the tub by way of outflow ports 17. Then a rinse fill cycle segment 58 is engageable by the timer switch blade 46 to control the time during which the valves 30 and 32 are again energized to supply rinse water to the tub 16. Following the rinse fill, a rinse agitate cycle segment 60 is engageable by the timer switch blade 46 to prescribe the duration of a second period during which the motor 26 is energized selectively to vertically reciprocate the agitator 18. Lastly, a spin dry cycle segment 62 is engageable by the timer switch blade 46 and adapted to control the length of time when the motor 26 is energized in reverse fashion to rotate the spin tub 16 in a centrifuging or damp drying operation. Note that the spin dry portion of a complete cycle is considerably longer than the spin portion following the wash agitate part of the cycle.

The complete washing cycle is controlled while the timer switch blade 46 advances intermittently throughout 360°. Between the spin dry segment 62 and the wash fill segment 52 the timer switch blade 46 will be disengaged from any electrically conducting segment and the washing cycle will be completed. Further, the knob 40 and the timer shaft 48 may be of the push-pull type for opening and closing a main line switch 64 to condition the timer for operation. Although the spacing between all segments other than 52 and 62 is close enough to insure that the switch blade 46 is engaged throughout the cycle with at least one of the segments, it should be appreciated that other means could be employed to insure that the switch blade 46 will move from one segment to the next without deenergizing the timer. For instance, the teeth on the ratchet wheel 50 could be designed to cause the switch blade 46 to jump the gap between all segments but the last, i.e., between 62 and 52.

Since the timer switch blade 46 is intermittently rotated throughout the washing cycle, an actuating pawl 66 is required. The pawl 66 is spring biased as by a spring 68 in opposition to a solenoid actuator coil 70. The solenoid actuator coil 70 is disposed in a timing circuit 69 including a four layer hyperconductive negative resistance transistor diode 72 and a capacitor 74. The actuator coil 70 is in series with the diode 72 while both the coil 70 and the diode 72 are in parallel with the capacitor 74. The timing circuit formed by the conductors 76 and 78 and the diode 72, the actuating coil 70 and the capacitor 74 form the parallel timing circuit 69 which is capable of providing intermittent timing pulses to the coil 70 for repeatedly actuating the pawl 66. Depending on the rapidity with which the solenoid 70 is actuated, the timer switch blade 46 will be advanced slow or fast during the washing cycle.

The firing rate of the coil 70 may be varied in accordance with resistances which are placed in series with the parallel timing circuit 69. The current flow, the capacitor charging rate and thus the firing frequency can be reduced by increasing the value of any resistance in series with the timing circuit. As shown in FIGURE 2, the solenoid actuating coil 70 is associated with an armature 80 for operating the pawl 66. As the pawl engages the ratchet wheel 50, the timer switch 46 is rotated in step by step fashion over each segment and from one

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cycle segment to another in a counterclockwise direction. As aforesaid, additional washing machine circuitry (not shown) for a particular cycle portion is effective only when its respective cycle segment is engaged by the timer switch blade 46. For instance, the fill valves 30 and 32 are energized only for that period in which the timer switch blade 46 engages either the wash fill segment 52 or the rinse fill segment 58. For additional details on the operation of the transistor diode or Dynistor timing circuit, reference may be had to the concurrently filed application Serial No. 71,581, assigned to the same assignee as this invention.

All of the various arcuate cycle segments 52, 54, 56, 58, 60 and 62 are of the same size. Thus for acquiring different cycle portion periods, it is necessary to include different resistances or power flow control means between the respective cycle segments and the transistor diode timing circuit 69. More particularly, the wash fill segment 52 and the rinse fill segment 58 are in series with a fill resistance 82. The period of wash agitation is determined by a rheostat or resistance 84 in series with the wash cycle segment 54. Note that the resistance 84 is of a variable type controlled by a wash time selector knob 44 on the washer console 14.

The duration of the wash water spin off period is governed by the spin cycle segment 56 which is in series with a wash spin resistance 86. A rinse agitate resistance 88 is connected to the rinse cycle segment 60 and in series with the timing circuit for determining the duration of the rinse agitate period. Lastly, the spin dry cycle segment 62 is in series with a spin dry resistance 90 and the timing circuit 69 to effect a longer spin dry period as a means to thoroughly centrifuge the moisture from the clothing. Note that the fill period is of short duration and, thus, requires a small resistance 82. On the other hand, the spin dry portion of controlled by a large resistance 90 and this conditions the timing circuit 69 for slow actuating pulses through the coil 70 and an extended drying period. The greater the value of the particular resistance, the lower is the frequency of pulses of the solenoid actuating coil 70. In other words, the timer switch blade 46 is advanced counterclockwise about the various cycle segments at different rotational speeds in accordance with the resistance placed in series with the timer switch blade and the timing circuit.

The operation of the clothes washer 10 is facilitated by the power supply L_1, L_2 . A rectifier 92 is positioned in one leg of the power supply in series with the timer switch blade 46 and is oriented so as to prevent flow of current through the diode 72 before the diode 72 reaches its switching or break down voltage. The other leg of the power supply L_2 is connected through a conductor 94 to one side of the parallel timing circuit 69. All of the resistances 82, 84, 86, 88 and 90 are connected through a conductor 96 to the opposite side of the parallel timing circuit. Each of these various resistances is preferably great enough to pass a current therethrough which is small enough so that when added to the capacitor discharge current, the total will in some instance be smaller than the holding current of the diode 72. The sine wave of the alternating current supply L_1, L_2 provides intermittent periods in which the supply voltage momentarily is zero and, during such periods, the current through the diode 72 is zero also.

For a 115-volt alternating current domestic power source, the diode 72 may, for example, have a switching or break down voltage of about 75 volts. One suitable diode 72 may be a four layer PNPM germanium diode, such as the Westinghouse WX Dynistor which has voltage-current characteristics providing for a break down or switching action. In the one direction of flow, the current will flow through the diode 72 with little resistance. This current flow, however, is in the direction of flow opposite to the direction of flow permitted by the rectifier 92 so that the current flow will be extremely limited.

In the opposite direction, the current flow will be substantially prevented until the break down voltage is reached. The break down voltage, if exceeded, permits peak currents of several amperes with little resistance. Both the germanium and silicon four layer diodes have this similarity in switching or break down voltage characteristics. The silicon diode is made up of an alternate P and N layers. However, the four layer diode of silicon type does not permit the free flow of current in the reverse direction as does the germanium type. Since flow is effectively prevented in this direction by the rectifier 92, this difference is immaterial. The concurrently filed application Serial No. 71,581 elaborates further on the theory of the timing circuit.

In operation the operator will place clothing within the spin tub 16 and turn the timer knob 40 counterclockwise to the FILL position while pushing in the knob to close the main line switch 64. Rotation of the knob 40 will place the timer switch blade 46 on the fill segment 52 and a circuit will be closed from L₁ through the main line switch 64, the rectifier 92, the timer switch blade 46, the wash fill segment 52, line 100, the fill resistance 82 to the timing circuit 69 and from there to the other side of the line L₂. Since the fill resistance 82 is relatively small, the capacitor 74 will charge and discharge through the diode 72 and the actuator coil 70 rather rapidly. This rapid actuation will cause the pawl 66 intermittently to rotate the ratchet 50 and the timer switch blade 46 over the wash fill contact 52.

Next the wash period will be governed as the timer switch blade 46 engages the wash cycle segment 54. The wash cycle segment 54 is in series with the variable resistance 84 and the timing circuit 69. Thus, in accordance with the positioning of the wash time selector 44, the pulsing rate of the actuating coil 70 will be more or less rapid to determine the length of time that wash agitation occurs.

Wash spin operation is controlled during the time that the timer switch blade 46 traverses the segment 56 and the resistance 86 will control the frequency of actuation of the coil 70 during this period.

Following the wash-spin operation, water is again supplied to the spin tube 16 as the timer switch blade 46 traverses the rinse-fill segment 58. The rinse fill segment 56 is again placed in series with the fill resistance 82 so that the same amount of fill may be provided. It should be understood that a different fill resistance 82 could be provided if different quantities of fill were required for wash and rinse.

Rinse agitate is accomplished while the timer switch blade 46 traverses the rinse agitate segment 60 wherein the rinse resistance 88 governs the pulsing rate of the timing circuit 69. Lastly, the timer switch 46 traverses the spin dry cycle segment 62 in series with the spin-dry resistance 90 and the actuating coil is operated at its slowest pulsating rate to cause the timer shaft 48 to be intermittently rotated very slowly. This increases the duration of the spin-dry period so that the spin tub 16 will be rotated for a considerably longer time than it was during the wash spin when the timer switch blade 46 engaged the wash spin contact 56.

It should now be seen that an improved simplified timing mechanism has been designed wherein the sequential advance of the timing device automatically selects means for varying the advancing rate to prescribe differently timed periods throughout the washing cycle. The combination of a compact, simple and sensitive timing circuit for pulsingly advancing the timing device is also a considerable advance over the prior art since a synchronous motorless device of this type may be installed in a relatively small area of the washing appliance. It should be understood that the explanation of the timing device hereinabove with a clothes washing machine is only representative. This timing mechanism could be used equally well

with any apparatus in which it is desired to control its operation throughout various differently timed periods.

While the embodiments of the present invention as herein disclosed, constitute preferred forms, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. In combination, an appliance timer comprising a first and a second contact, a switch blade for sequentially engaging said contacts and ratchet means comprising the sole means for moving said switch blade between said contacts, a solenoid actuator for actuating said ratchet means, a negative resistance diode connected in series with said solenoid actuator, said diode having a predetermined switching voltage, a capacitor connected in a parallel circuit with the actuator and diode, said capacitor being capable of being charged to a voltage great enough to exceed the switching voltage of said diode, a rectifier connected in series with said switch blade and oriented to prevent flow of current through said diode before said diode reaches its switching voltage, an alternating current power supply having a peak output voltage greater than the switching voltage of said diode for supplying energy to said rectifier and said parallel circuit for repeatedly operating said actuator, said negative resistance diode being in the form of a four layer transistor, a first resistance connected to said first contact, and a second resistance connected to said second contact, said resistances being in parallel with each other and connected in series with said parallel circuit.

2. In combination, an appliance timer comprising a first and a second contact, a switch blade for sequentially engaging said contacts and ratchet means comprising the sole means for moving said switch blade between said contacts, a solenoid actuator for actuating said ratchet means, a negative resistance diode connected in series with said solenoid actuator, said diode having a predetermined switching voltage, a capacitor connected in a parallel circuit with the actuator and diode, said capacitor being capable of being charged to a voltage great enough to exceed the switching voltage of said diode, a rectifier connected in series with said switch blade and oriented to prevent flow of current through said diode before said diode reaches its switching voltage, an alternating current power supply having a peak output voltage greater than the switching voltage of said diode for supplying energy to said rectifier and said parallel circuit for repeatedly operating said actuator, said negative resistance diode being in the form of a four layer transistor, a first resistance connected to said first contact, and a second resistance connected to said second contact, said resistances having different values and being in parallel with each other and connected in series with said parallel circuit.

3. In combination, an appliance timer comprising a first and a second contact, a switch blade for sequentially engaging said contacts and ratchet means comprising the sole means for moving said switch blade between said contacts, a solenoid actuator for actuating said ratchet means, a negative resistance diode connected in series with said solenoid actuator, said diode having a predetermined switching voltage, a capacitor connected in a parallel circuit with the actuator and diode, said capacitor being capable of being charged to a voltage great enough to exceed the switching voltage of said diode, a rectifier connected in series with said switch blade and oriented to prevent flow of current through said diode before said diode reaches its switching voltage, an alternating current power supply having a peak output voltage greater than the switching voltage of said diode for supplying energy to said rectifier and said parallel circuit for repeatedly operating said actuator, said negative resistance diode being in the form of a four layer transistor, a fixed resistance connected to said first contact, and a variable resistance connected to said second contact, said resistances being in parallel with each other and connected in series with said parallel circuit.

4. In combination, a timer comprising a first and second contact, means for sequentially electrically engaging said contacts and means comprising the sole means for moving said engaging means from one of said contacts to the other of said contacts, an actuator coil for actuating said moving means, a negative resistance diode connected in series with said actuator coil, said diode having a predetermined switching voltage, a capacitor connected in a parallel circuit with the actuator coil and diode, said capacitor being capable of being charged to a voltage great enough to exceed the switching voltage of said diode, a rectifier connected in series with said engaging means and oriented to prevent flow of current through said diode before said diode reaches its switching voltage, an alternating current power supply having a peak output voltage greater than the switching voltage of said diode for supplying energy to said rectifier and said parallel circuit for repeatedly operating said actuator coil, a first resistance connected to said first contact, and a second resistance connected to said second contact, said resistances being in parallel with each other and connected in series with said parallel circuit, whereby the frequency of the repeated operation of said actuator coil depends on the contact with which said engaging means is engaged.

5. The combination of claim 4 wherein one of said resistances is variable.

6. The combination of claim 4 wherein said contacts are elongated electrically conducting segments.

7. The combination of claim 4 wherein said negative resistance diode is in the form of a four layer transistor.

8. An electrical timing device comprising a sole driving means, a driven means connected to said driving means and actuatable into sequential association with a plurality of stations for controlling the multiple functions of a timing cycle, means for periodically actuating said driving means to intermittently advance said driven means into sequential association with said plurality of stations to control the multiple functions of said cycle, and means responsive to the association of said driven means with said plurality of stations for selectively changing the period of intermittency of said driving means in accordance with the station with which said driven means is associated, said responsive means including a plurality

of different resistance means, each of said resistance means being connected to a different one of said stations, and transistor diode timing circuit means in control relationship with said actuating means and in electrical series power flow arrangement with the one of said plurality of different resistance means connected to the station with which said driven means is associated whereby the rate of periodic actuation of said driving means is determined in accordance with the particular resistance means in series with said timing circuit means.

9. An electrical timing device comprising a sole driving means, a driven means connected to said driving means and actuatable into sequential association with a plurality of stations for controlling the multiple functions of a timing cycle, means for periodically actuating said driving means to intermittently advance said driven means into sequential association with said plurality of stations to control the multiple functions of said cycle, and means responsive to the association of said driven means with said plurality of stations for selectively changing the period of intermittency of said driving means in accordance with the station with which said driven means is associated, said responsive means including a plurality of different power flow control means, each of said power flow control means being connected to a different one of said stations, and transistor diode timing circuit means in control relationship with said actuating means and in electrical series power flow arrangement with the one of said plurality of different power flow control means connected to the station with which said driven means is associated whereby the rate of periodic actuation of said driving means is determined in accordance with the particular power flow control means in series with said timing circuit means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,288,458	Jeffers	June 30, 1942
2,350,409	Melcher	June 6, 1944
2,383,328	Lyle	Aug. 21, 1945
2,502,823	Clark	Apr. 4, 1950
2,956,489	Carter	Oct. 18, 1960
3,013,166	Dunlap	Dec. 12, 1961
3,063,643	Roberts	Nov. 13, 1962