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TIMING CIRCUIT WITH MEANS FOR SELECTIVELY ALTERNATING THE TIMING PULSES

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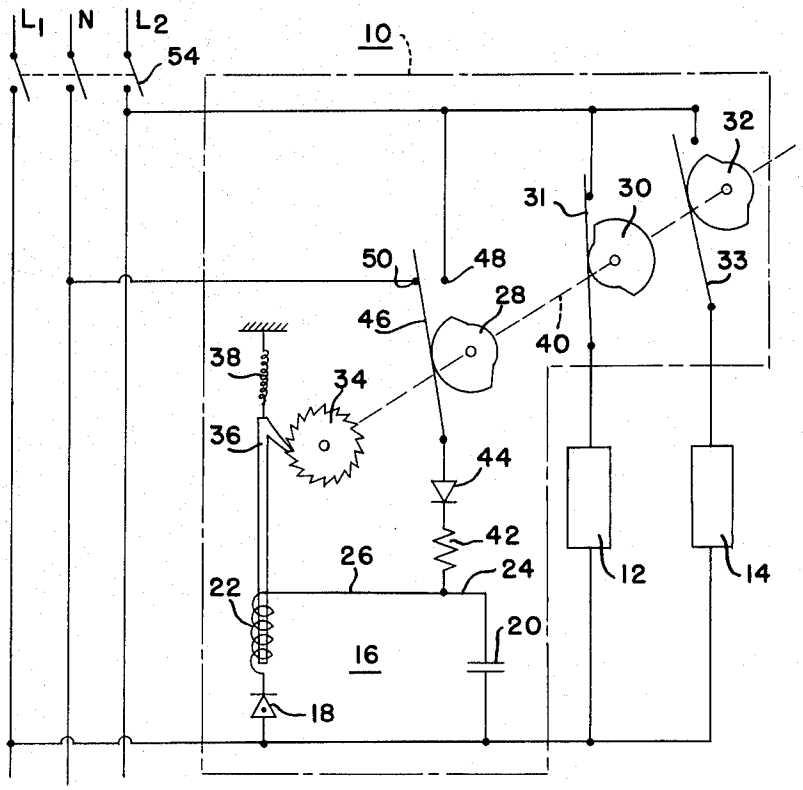


Fig. 1

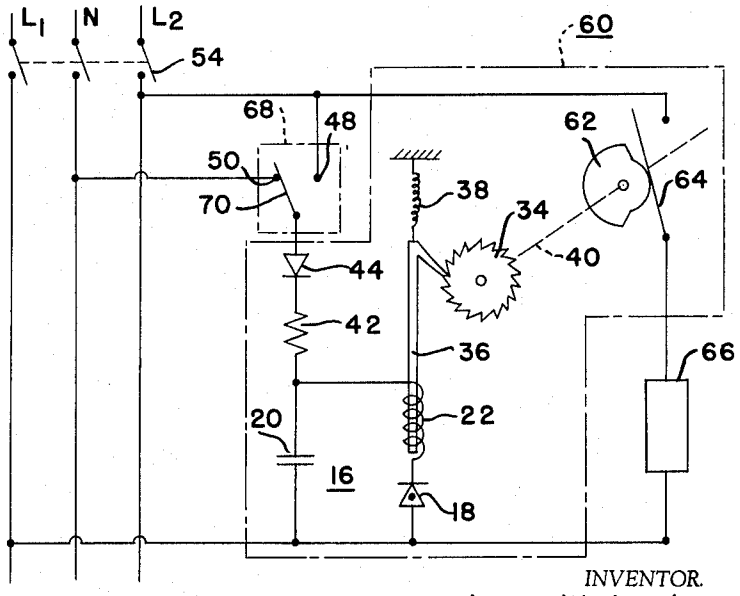


Fig. 2

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TIMING CIRCUIT WITH MEANS FOR SELECTIVELY ALTERNATING THE TIMING PULSES

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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 automatic operation of many appliances is controlled by timers and, thus, the complexity of these timers is a matter of concern in the development of low cost dependable products. One of the more common timing arrangements on the market today involves the use of and escapement mechanism with a drive motor to intermittently advance a plurality of cams for sequentially controlling a timed cycle. In view of the cost and complexity of escapement mechanisms, it is a general 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 transistor diode timing circuit with means for selectively varying the timing rate of said circuit in accordance with the voltage of power supplied to said circuit.

Another object of this invention is the provision of a timer using a transistor diode timing circuit with means for automatically changing the voltage of power supplied to said timing circuit, thereby to alter the timing rate of said timer during the timed cycle.

It is broadly an object of this invention to selectively vary the timing rate of a timer in accordance with voltage supplied to said timer.

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 schematic wiring diagram of a timer, the timing rate of which is shifted automatically in accordance with voltage supplied to the timer; and

FIGURE 2 is a schematic wiring diagram of another embodiment of this invention wherein the timing rate is manually selectable.

In accordance with this invention and with reference to FIGURE 1, a timer **10** is shown interposed between a 230 volts A.C. or 115 volts A.C. power supply, generally designated as L_1, L_2, and N. The timer **10** is adapted to sequence a plurality of loads **12** and **14**. These loads could be components of a domestic appliance such as the fill valve and drive motor in a clothes washer. Although both loads **12** and **14** are shown connected across 230 volts, it should be understood that the loads could be connected equally as well to the smaller voltage 115-volt supply or selectively to either supply.

The timer **10** is comprised of a transistor diode timing circuit **16** including a four-layer hyper-conductive negative resistance transistor diode **18**, a capacitor **20**, and an actuator or solenoid coil **22**. The actuator coil **22** is in series with the diode **18** while both the coil **22** and the diode **18** are in parallel with the capacitor **20**. The timing circuit formed by conductors **24**, **26**, the diode **18**, the actuating coil **22** and the capacitor **20** form the parallel timing circuit **16** which is capable of providing intermittent timing pulses through the coil **22** for repeatedly advancing a plurality of timer cams **28**, **30** and **32** by incrementally rotating a shaft **40** to which the cams are attached. More particularly, the cams are intermittently roated through a ratchet wheel **34** affixed to the shaft **40** and a pawl **36**—the pawl being actuated whenever the coil **22** is energized. A return spring **38** may be connected to a fixed structure to return the pawl whenever the coil **22** is deenergized.

In series with the timing circuit **16** is a resistance **42** and a rectifier diode **44**—these components being in series with a cam actuated voltage selector switch **46** movable between a high voltage contact **48** and a low voltage contact **50**. The firing rate of the coil **22** on a given voltage may be predetermined in accordance with the size of the resistance **42**, but this firing rate is alterable in accordance with the voltage connection of the cam actuated switch **46**. Thus, when the switch **46** is connected to the contact **50**, the timing circuit **16** is energized from the 115-volt power supply and the timing rate is approximately one-half that accomplished when the switch **46** is energized through the high voltage contact **48**. In other words, the firing rate of the timing circuit **16** varies linearly with its voltage supply.

For a common 115–230-volt alternating current power source, the diode **18** may, for example, have a switching or breakdown voltage of about 75 volts. One suitable diode may be a four-layer PNPM germanium diode, such as the Westinghouse WX Dynistor which has voltage-current characteristics providing for a certain breakdown or switching action, assuming, of course, that the peak voltages of the power supply are greater than the switching voltage of the diode. In the one direction of flow, the current will flow through the diode **18** with little resistance. The current flow, however, is in the direction of flow opposite to the direction of flow permitted by the rectifier **44** so that the current flow will be extremely limited. In the opposite direction, the current flow will be substantially prevented until the breakdown voltage is reached. The breakdown voltage, if exceeded, permits peak currents of several amperes with little resistance and this is sufficient to operate solenoid actuators which can operate the pawl and ratchet **34**, **36**.

In operation, assume that a master line switch **54** is closed to energize the timer **10**. With the circuitry shown in FIGURE 1, 115-volt A.C. power is supplied through the low voltage contact **50** to the rectifier diode **44**, the resistor **42** and then the capacitor **20** to the other side of the line L_1. This provides pulses of rectified A.C. current to the capacitor. The capacitor gradually builds up a charge as permitted by the RC time constant until a sufficient voltage is reached to cause the four-layer diode **18** to breakdown and avalanche, thereby discharging the capacitor through the actuating coil **22**. Each pulse of the coil **22** causes the cams **28**, **30** and **32** to index or advance. With the cam arrangement illustrated in FIGURE 1, the load **12** would be energized from L_2 cam switch **31**, the load **12** to the other side of the line L_1. Since cam switch **33** is open, load **14** will be deenergized during this portion of the control cycle. At a predetermined point in the controlled cycle during one of the incremental advances, cam **28** will cause the voltage selector switch **46** to shift from the low voltage contact **50** to the high voltage contact **48** and the timing circuit **16** will be energized from 230-volt power supply instead of 115-volt. This, in effect, doubles the firing rate of the coil **22** and causes the cams **28**, **30** and **32** to advance more rapidly. During the last portion of the timing cycle illustrated, the cam switch **31** for load **12** will be opened while the switch **33** for load **14** will be closed. In this situation and even though the cams **28**, **30** and **32** are designed with equal 180° segments devoted to the control of their respective loads, the load **14** will be energized only half as long as load **12**.

In the foregoing embodiment, the speed or firing rate of the timer **10** was automatically changed during the course of the cycle controlled. Turning now to FIGURE 2, there is shown a timer **60** having the same timing circuit **16** and a cam **62** for operating the switch **64** in series circuit relationship with a load **66**. The embodiment of FIGURE 2 varies over that in FIGURE 1 in that a manual cycle speed selector **68** is interposed between the power supply and the timer **60**. The speed selector includes a switch **70** operating between the low voltage contact **50** and the high voltage contact **48**. Thus, whenever the operator wishes to operate the load **66** for a short period of time, the switch **70** may be set against the high voltage contact **48**. In this manner, the timing circuit **16** will fire the coil **22** approximately twice as often as would occur if the switch **70** were against the low voltage contact **50**, assuming a 115-volt–230-volt power supply. Should different timing rates be desired, it is well within the skill of the art to provide voltage varying means to achieve the precise firing rate needed in the timer. The RC time constant of resistance **42** and capacitor **20** may also be predetermined for this purpose.

It should now be seen that an improved electrical timing device has been developed wherein the voltage of the power supply may be used to alter the timing pulses of the timer. These alterations can be made manually to select a longer or shorter duration for a given cycle portion or they can be made automatically by the timer itself, thereby to alter the duration of selected portions of a complete timing cycle. The foregoing explanation with reference to the timing circuit is believed sufficient for an understanding of this invention. However, for additional details on the theory of the transistor diode timing circuit, reference may be had to the assignee's copending application, Serial No. 71,581.

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 with a first and second load to be sequenced and an alternating current power supply having a first peak output voltage conductor and a second peak output voltage conductor, a timer comprising a first contact connected to said first voltage conductor and second, third and fourth contacts connected to said second voltage conductor, said first and second load being energized respectively through said third and fourth contacts, first, second and third switch means for sequentially electrically engaging said contacts, said first switch means engageable with said first or second contact, said second switch means connected to one side of said first load and engageable with said third contact, said third switch means connected to one side of said second load and engageable with said fourth contact, and means for moving said switch means including a cam shaft connected to said switch means, means for rotating said cam shaft and timing means for intermittently actuating said rotating means, said timing means including an actuator coil for actuating said rotating 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 first switch means and one side of said parallel circuit and oriented to prevent flow of current through said diode before said dode reaches its switching voltage, circuit means connected to the other sides of said parallel circuit and said first and second loads for completing a circuit with said power supply, said peak output voltages of said power supply being greater than the switching voltage of said diode for selectively supplying energy to said rectifier and said parallel circuit for repeatedly operating said actuator coil at one frequency when said first switch means is engaged with said first contact and at another frequency when said first switch means is engaged with said second contact.

2. In combination with a first and second load to be sequenced and an alternating current power supply having a low output voltage conductor and a high output voltage conductor, a timer comprising a first contact connected to said low voltage conductor and second, third and fourth contacts connected to said high voltage conductor, said first and second load being energized respectively through said third and fourth contacts, first, second and third switch means for sequentially electrically engaging said contacts, said first switch means engageable with said first or second contact, said second switch means connected to one side of said first load and engageable with said third contact, said third switch means connected to one side of said second load and engageable with said fourth contact, and means for moving said switch means including a cam shaft connected to said switch means, pawl and ratchet means for rotating said cam shaft and timing means for intermittently actuating said pawl and ratchet means, said timing means including an actuator coil for actuating the pawl of said pawl and ratchet 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 first switch means and one side of said parallel circuit and oriented to prevent flow of current through said diode before said diode reaches its switching voltage, circuit means connected to the other sides of said parallel circuit and said first and second loads for completing a circuit with said power supply, said high and low output voltages of said power supply being greater than the switching voltage of said diode for selectively supplying energy to said rectifier and said parallel circuit for repeatedly operating said actuator coil at low frequency when said first switch means is engaged with said first contact and at high frequency when said first switch means is engaged with said second contact.

3. In combination with a load to be controlled and an alternating current power supply having a first voltage conductor and a second voltage conductor, a timer speed selector switch having a first position in engagement with said first voltage conductor and a second position in engagement with said second voltage conductor, a timer comprising a contact connected to one of said voltage conductors, said load being energized through said contact, switch means connected to one side of said load for selectively electrically engaging said contact and means for moving said switch means including a cam shaft means connected to said switch means, means for rotating said cam shaft means and timing means for intermittently actuating said rotating means, said timing means including an actuator coil for actuating said rotating means, a negative resistance diode connected in series with said actuator coil, said diode having a predetermined switch 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 timer speed selector switch and one side of said parallel circuit and oriented to prevent flow of current through said diode before said diode reaches its switching voltage, means connecting the other side of said parallel circuit and said load for completing a circuit with said power supply, said voltages of said power supply being greater than the switching voltage of said diode for supplying energy to said rectifier and said parallel circuit for repeatedly operating said actuator coil at one frequency when said timer speed selector switch

is in said first position and at another frequency when said timer speed selector switch is in said second position.

4. The combination of claim **3** wherein said timer speed selector switch is moved between said first and second positions by said cam shaft means.

5. The combination of claim **3** wherein said timer speed selector switch is manually movable between said first and second positions.

6. In combination, an electrical timing device comprising a driving means, a driven means connected to said driving means for controlling the multiple functions of a timing cycle, a power source having high and low voltage conductors, means selectively connected to the high or low voltage conductor of said power source by said driven means for periodically actuating said driving means to intermittently advance said driven means through the multiple functions of said cycle, said actuating means including means responsive to the voltage of the conductor connected to said actuating means for determining the period of intermittency of said driving means thereby to control the duration of each of said multiple functions.

7. In combination, an electrical timing device comprising a driving means, a driven means connected to said driving means for controlling the multiple functions of a timing cycle, a power source having high and low voltage conductors, means selectively connected to the high or low voltage conductor of said power source for periodically actuating said driving means to intermittently advance said driven means through the multiple functions of said cycle, said actuating means including means responsive to the voltage of the conductor connected to said actuating means for determining the period of intermittency of said driving means thereby to control the duration of said timing cycle.

8. In combination with a load energizable in a timed cycle, timer switch means in power supply relationship to said load actuatable to energize said load in a timed cycle for a long or short interval, an electrical timing device comprising a driving means, a driven means advancedly connected to said driving means and actuatably related to said timer switch means for controlling said timed cycle by actuating said timer switch means, a power source having a low output voltage conductor and a high output voltage conductor, actuating means selectively connectable to the low and high output voltage conductors of said power source for periodically actuating said driving means to intermittently advance said driven means during said timed cycle, said actuating means including means responsive to the voltage of the conductor connected to said actuating means for determining the period of intermittency of said driving means thereby to control the duration of said time cycle, and means for completing a circuit with said actuating means and said load, said load being energized for said long interval when said actuating means is connected to said low output voltage conductor, and said load being energized for said short interval when said actuating means is connected to said high output voltage conductor.

9. The combination of claim **8** wherein said voltage responsive means includes an actuator coil operably connected to said driving means, a negative resistance diode in series with said actuator coil, a capacitor connected in a parallel circuit with said actuator coil and diode, a rectifier in series with said parallel circuit and a resistance in series with said rectifier.

10. The combination of claim **8** wherein said voltage responsive means includes an actuator coil operably connected to said driving means, semi-conductor switch means in series with said actuator coil, capacitor means connected in a parallel circuit with said actuator coil and semi-conductor switch means, rectifier means in series with said parallel circuit and resistance means in series with said rectifier means.

11. In combination with a load to be controlled and an alternating current power supply having a first voltage conductor and a second voltage conductor, a timer speed selector switch having a first position in engagement with said first voltage conductor and a second position in engagement with said second voltage conductor, a timer comprising a contact connected to one of said voltage conductors, said load being energized through said contact, switch means connected to one side of said load for selectively electrically engaging said contact and means for moving said switch means including actuator means drivably connected to said switch means, means for operating said actuator means and timing means for intermittently actuating said operating means, said timing means including an actuator coil for actuating said operating means, a negative resistance diode connected in series with said actuator coil, said diode having a predetermined switch 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 timer speed selector switch and one side of said parallel circuit and oriented to prevent flow of current through said diode before said diode reaches its switching voltage, means connecting the other side of said parallel circuit and said load for completing a circuit with said power supply, said voltages of said power supply being greater than the switching voltage of said diode for supplying energy to said rectifier and said parallel circuit for repeatedly operating said actuator coil at one frequency when said timer speed selector switch is in said first position and at another frequency when said timer speed selector switch is in said second position.

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