TIME CONTROL SYSTEM

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21 Claims.

(34—19)

2. A time control system for closing a circuit a predetermined length of time after the closing of another circuit, which closes a circuit a predetermined length of time after the closing of another circuit, it being necessary to rid the oven of highly combustible and explosive gases before the gas is turned on,

5 Consequently, provision is hereby made for operating the exhaust fan a predetermined length of time before the gas is turned on to heat the gas-fired oven.

10 Referring now to Fig. 1, the exhaust fan is diagrammatically shown and designated at 10 and is operated by an electric motor 11, and the gas valve is diagrammatically shown and designated at 12, and it is operated by a solenoid 13. These structures are old in the art, and a more specific description thereof is not considered necessary.

15 14 and 15 designate line wires leading from some power source (not shown), and they are connected at times by means of a double-poled single-throw switch 16 to wires 17 and 18 which lead to the fan motor 11. When the switch 16 is closed, current flows through wires 17 and 18 from the line wires 14 and 15 to operate the motor 11 to drive the exhaust fan 10.

20 A switch in the form of a push button 20 is connected by means of a wire 19 to the wire 17 and by a wire 21 to a coil 22 forming the field of an electric timing motor having a rotor 23. The other end of the field 22 of the electric timing motor is connected to the wire 18 by means of a wire 24. When the push button switch 20 is closed by pressing thereon, a circuit is completed from wire 17 through wire 19, switch 20, wire 21, coil 22, and wire 24 to wire 18 to energize the timing motor to rotate the rotor 23. When the switch 20 is opened by relieving the pressure thereon, field coil 22 of the motor is not energized by the above circuit. The above circuit when closed completes a starting circuit for the motor.

25 The motor rotor 23 has a motor pinion 25 which drives a reduction gear train generally designated at 26 to rotate the cam 27, 28, and 29. The reduction gearing 26 may be of any desired type and may reduce the speed of the cam 27, 28, and 29 with respect to the motor rotor 23 as desired, determined upon the amount of rotation of the cam required in a given interval of time. Cam 27 has a low dwell 30 thereon of comparatively short length, while cam 28 has a high dwell 31 thereon, also of comparatively short length. The cam designated generally at 29 is made up of two cooperating cam discs 22 and 23, the cam disc 22 being fixed for rotation, and the cam disc 23 being adjustable relative to the cam disc 22 by means of a slot 34 located in the cam disc 23 and a pin 35 secured to the cam disc 22 operating in said slot. Suitable means are provided on the pin 35 to maintain the cam discs 22 and 23 in place.
in their relative adjusted positions. It will be noted that the cam discs 32 and 33 have high dwells of substantially 180° so that when the high dwells of the cam discs 32 and 33 are adjacent to each other, the effective surface of the cam 29 is substantially 180°. This effective surface is increased by rotating the cam disc 33 with respect to the cam disc 32, and the amount of such rotation determines the effective length of the dwell 25 of the cam 29. By this means the effective dwell of cam 29 may vary in amount from substantially 180° to almost 360°.

The cams 27, 28, and 29 are fixed in a definite relation with respect to each other. By rotating the cams 27, 28, and 29 in a counter-clockwise direction as shown by the arrows, low dwell 30 of cam 27 becomes effective first, then the high dwell of the cam disc 31 becomes effective, and then the high dwell 31 of the cam 29 becomes effective in that definite sequence.

Cooperating with the cam 27 is a cam follower 36 having a contact 37 thereon which engages a stationary contact 38 when the follower 36 is out of engagement with the low dwell 30 of the cam 27. Cooperating with the cam 28 is a cam follower 39 having a contact 40 thereon which engages the stationary contact 41 when the high dwell 31 of the cam 29 engages its follower 35. Cooperating with the cam 29 is a cam follower 42 having a contact 43 thereon which engages the stationary contact 44 when the cam follower 44 is out of engagement with the high dwell of the cam 29.

Assuming that the parts are in the positions shown in Fig. 1, the motor is energized to rotate the cams 27, 28, and 29 in a counter-clockwise direction. The first sequence of operation caused thereby is the closing of the contacts 27 and 38; the second sequence is the opening of the contacts 43 and 44; and the third sequence is the closing of the contacts 45 and 46. It will be noted from this construction that contacts 37 and 38 are open only momentarily, that contacts 43 and 44 are open for a comparatively long time, and that contacts 45 and 46 are closed only momentarily.

Wire 21 is connected by means of a wire 46 with the movable contact 37, and the stationary contact 46 is connected by a wire 46 to a wire 45. Wire 52 which is connected to one side of a cut-out switch 55. The other side of the cut-out switch 55 is connected by means of a wire 54 to the wire 17. The switch 55 is normally closed, but upon opening it affords a means for shutting down the timing system in a manner which will be pointed out more clearly hereafter. The switch 55 may also take the form of a simple push button switch since it is necessary only to break the circuit controlled thereby momentarily to cause a shut down. This wiring completes a holding circuit from the wire 11 through the wire 46, switch 55, wire 52, wire 45, contact 46, contact 37, wire 54, wire 21, coil 22, and wire 24 to wire 18. By reason of this circuit, the field coil 22 of the motor is maintained energized when the contacts 37 and 38 are in engagement even though the push button switch 28 is open.

A coil 47 of a relay is connected to the field coil 22 of the motor by means of a wire 56. The other end of the relay coil 56 is connected by means of a wire 57 to a wire 50 which is connected to the movable contact 40 of the cam follower 39, and the cooperating stationary contact 41 is connected by a wire 56 to the wire 51. When the high dwell 31 of the cam 29 engages the cam follower 39 to cause contacts 40 and 41 to engage, a timing starting circuit is completed from the wire 17 through wire 54, cut-out switch 55, wire 52, wire 45, stationary contact 41, movable contact 40, wire 56, wire 57, relay coil 56, 6 wire 56, and wire 24 to wire 18. Wire 56 and 51 designate switch arms which are normally maintained in the right position by means of springs or gravity or other means (not shown), and they are operatively connected together and to the relay coil 56 by means of a rod 51. Switch arms 50 and 51 are moved to the left upon energization of the coil 56 to engage contacts 50 and 51, respectively. When the coil 56 is energized, the switches 50 and 51 are 15 moved out of engagement with the contacts 50 and 56, respectively. Switch arm 56 is connected by means of a wire 56 with the wire 65.

When the relay coil 56 is energized to move switch arm 50 into engagement with switch arm 53 upon closing of the timing starting circuit outlined above, a timing holding circuit is completed by this movement from wire 17 through wire 65, cut-out switch 55, wire 52, wire 45, stationary contact 41, movable contact 50, wire 56, wire 57, wire 17, and coil 22 of the motor. When the switch arm 51 is moved into engagement with the contact 65 by the relay coil 56 in the manner pointed out above, and when the contact 51 engages the stationary contact 45 by reason of the cam follower 42 moving off of the high dwell of the cam 29, a valve operating circuit is completed from wire 17 through wire 56, cut-out switch 55, wire 52, wire 65, movable contact 45, stationary contact 65, wire 57, contact 46, switch arm 51, wire 66, solenoid 13, and wire 93 to wire 18. When this valve operating circuit is completed in the manner pointed out immediately above, solenoid 13 is energized to open valve 13 to permit flow of gas from some source (not shown) into the gas fired oven (not shown). This valve operating circuit is broken either by disengagement of contacts 43 and 44 or by disengagement of switch arm 41 from contact 64.

The operation of the device is as follows: Assuming that the parts are in the normal off position, as shown in Fig. 1, switch 16 is closed to energize the motor 61 to operate the exhaust fan 10. When push button switch 28 is closed by manually closing the switch thereon, the timing motor starting circuit is completed therethrough to energize the field coil 22 to rotate the rotor 23 of the timing motor. Rotation of this motor causes counter-clockwise rotation of the cams 27, 28, and 29 in the direction shown by the arrows through the switch 28. This motor operation then energization of movement of the cams 27, 28, and 29 causes follower 36 by reason of its riding out of the low dwell 30 of cam 27 to close contacts 37 and 38, thereby causing the timing motor holding circuit to continue energization of the field coil 22 of the timing motor to continue the rotation of the rotor 23, and consequently the cams 27, 28, and 29. After contacts 37 and 38 are brought
A further increment of movement causes the high dwell of cam disc 32 to engage the cam follower 42 to separate the contacts 43 and 44. A still further increment of movement causes the high dwell 31 of cam 28 to engage cam follower 45, thereby completing the timing starting circuit as outlined above. Upon completion of this timing starting circuit, coil 56 is energized to draw switches 60 and 61 into engagement with contacts 53 and 64, respectively. When switch 68 engages contact 63, a timing holding circuit is completed as outlined above to maintain the coil 56 energized. Since the coil 56 is energized by this timing holding circuit, the separation of the contacts 40 and 41 by reason of the high dwell 31 of the cam 28 disengaging the cam follower 39 will not affect the relay coil 56. Since contacts 43 and 44 were separated by the above mentioned second increment of movement, a circuit is not completed by the engagement of switch arm 61 with contact 64 to open the valve 12. Upon further rotation of the timing motor, and consequently the cams 27, 28, and 29, contacts 43 and 44 will be held separated until the cam follower 42 rides off of the high dwell of the cam disc 33, whereby contacts 43 and 44 engage to complete the valve operating circuit, outlined above, to energize solenoid 13 to open the valve 12 to admit gas into the gas fired oven. The length of the high dwell of the cam 29 determines the timing cycle which is required to take effect before the gas valve 12 is opened, and by increasing or decreasing the effective length of the high dwell of the cam 29 in the manner described above, the time interval of the timing cycle may be increased or decreased.

Upon further movement, which total movement amounts to substantially 360°, cam follower 36 rides into the low dwell 30 of the cam 27 to separate contacts 37 and 38 to open the timing motor holding circuit to deenergize the field coil 56 and to stop rotation of the rotor 23, and consequently the cams 27, 28, and 29. Since at this point the relay coil 56 is energized by reason of the timing holding circuit to maintain the switch arm 61 in engagement with the contact 64, and since the contacts 43 and 44 are still engaged, the valve operating circuit is still closed, and gas is still being sent through the valve 12 into the gas fired oven.

In order to shut off the flow of gas through the gas valve 12 and still maintain the fan 10 in operation, switch 53 is opened to break the timing holding circuit and the valve operating circuit to deenergize the solenoid 13 to permit closing of the valve 12. If it be desired to stop the operation of the fan 10 and close the valve 12, or, in other words, effect a complete shut-down of the device, switch 16 is opened.

Since the relay coil 56 is energized during the timing cycle and also during the period after the timing cycle has been completed, a power failure in the lines 14 and 15 will be directly reflected by deenergization of the relay coil 56. When the coil 56 is so deenergized, switch arms 60 and 61 are moved out of engagement with contacts 63 and 64 to open the timing holding circuit and the valve operating circuit, thereby deenergizing the solenoid 13 and permitting closing of the valve 12 to shut off the gas supply to the gas fired oven. Since upon power failure the switch arms 60 and 61 are moved out of engagement with the contacts 63 and 64 by deenergization of the coil 56, coil 56 may not be reenergized upon resumption of power until the high dwell 31 of the cam 28 engages the cam follower 39 to close contacts 40 and 41 to complete the timing starting circuit outlined above. By reason of this, it is necessary to operate the timing mechanism through a new and complete timing cycle in the manner pointed out above.

By this construction a valve operating circuit is closed a predetermined time after the closing of the motor starting circuit, and in no way is it possible to close this valve operating circuit until this interval of time has elapsed. Even if power failure occurs during this timing cycle, by the construction shown and described this predetermined time cycle cannot be decreased upon resumption of power in the lines 14 and 15.

Referring now to Fig. 2 wherein is shown another form of my invention, it is contemplated to use the same exhaust fan 10 driven by the electric motor 11 and the same gas valve 12 operated by the solenoid 13. A similar timing motor is used having the motor field coil 22 and a rotor 23 which drives a motor pinion 25 which drives through a suitable gear reduction 26 cams 27, 28, and 29. In this modification, as in the previous modification, cam 27 has a low dwell 33 of relatively short duration, cam 28 has a high dwell 31 of relatively short duration, and cam 29 comprised of cam discs 32 and 33 made adjustable by means of the slot 34 and pin 35 has a variable high dwell adjustable from substantially 180° to about 360°.

Here again, the low dwell 30 of cam 21 coats with a cam follower 36 to make and break contacts 37 and 38, and the high dwell 31 of the cam 29 coats with the cam follower 39 to make and break contacts 40 and 41. The high dwell of the cam discs 32 and 33 of the cam 29 coat with the cam follower 42 to make and break the contacts 43 and 44 as above. This modification also contemplates the use of the same relay having the same coil 56.

This modification, however, omits the push button switch 20 and the cut-out switch 53. Switch 50 designates a switch arm movable alternately into engagement with contacts 71 and 72. Switch 73 designates a switch arm which moves into engagement with a contact 74. The switch arms 70 and 73 are connected together by means of a rod 75 for synchronous movement, and this rod 75 is operated by the relay coil 56 to move the switch arms 70 and 73 from one position to the other. Upon energization of the coil 56, switch arm 70 is moved out of engagement with contact 72 and into engagement with contact 71, and switch arm 73 is moved into engagement with contact 74 by the rod 75. Upon deenergization of the relay coil 56, the switch arm 73 is moved out of engagement with the contact 74, and the switch arm 70 is moved out of engagement with the contact 71 and into engagement with the contact 72 by means of springs, gravity, or some other means (not shown). Switches 76 and 77 designate line wires leading from some source (not shown) which are engaged by means of a bi-pole switch 78 to transmit energy into the wires 79 and 80 which lead to the exhaust fan motor 11. When the switch 78 is closed the motor 11 is energized to operate the exhaust fan 10. The wire 79 is connected by means of a wire 81, a wire 82, a wire 83, 75
and a wire 86 to the switch arm 78. The contacts 57 is connected by means of a wire 85 and a wire 86 to one end of the field coil 22 of the timing motor, and the other end of the field coil 22 is connected by a wire 87 and a wire 88 to the wire 66. These connections complete a timing motor starting circuit from wire 79 through wire 81, wire 82, wire 83, wire 84, switch arm 70, contact 72, wire 85, wire 86, field coil 22, wire 87, and wire 88 to wire 66 to energize the field coil 22 of the timing motor to rotate the rotor 23 upon closing of the switch 75. Rotor 23 drives the cams 27 and 28 through the gear reduction 26 in exactly the same manner as in the modification pointed out above.

Wire 82 is connected to contact 38 by means of wire 92 to complete a timing motor holding circuit from wire 79 through wire 81, wire 82, wire 83, contact 38, wire 86, field coil 22, wire 67, and wire 68 to wire 68 upon the closing of contacts 37 and 38 by the riding out of the cam follower 85 from the low dwell 32 of the cam 27.

Movably contact 40 is connected by means of a wire 86 and a wire 81 to one end of the relay coil 56, and the other end of the relay coil 56 is connected by a wire 92 to the wire 86. These connections complete a timing starting circuit upon engagement of contacts 40 and 41 caused by the low dwell 31 of the cam 29 engaging the cam follower 85, from wire 79 through wire 81, wire 82, wire 83, stationary contact 41, movable contact 40, wire 90, wire 91, relay coil 56, wire 92, and wire 88 to wire 68.

When the relay coil 56 is so energized it moves switch arm 70 out of engagement with contact 72 and into engagement with contact 71 and moves switch arm 73 into engagement with contact 74. By reason of switch arm 70 engaging contact 71 in the manner just described, a timing holding circuit is completed from wire 79 through wire 81, wire 82, wire 83, wire 84, switch arm 70, contact 71, wire 91, relay coil 56, wire 92, and wire 88 to wire 68 to maintain the relay coil 56 energized whether or not contacts 40 and 41 are disengaged.

Wire 81 is connected by means of a wire 93 with the movable contact 45, and the stationary contact 44 is connected by means of a wire 94 with the contact 14. The switch arm 73 is connected by means of a wire 95 to the solenoid 12, and the solenoid 13 is connected by a wire 96 to the wire 68.

When switch arm 73 engages contact 74 and when contact 43 engages contact 44 by reason of the cam follower 42 sliding off of the high dwell of the cam discs 32 and 33 of the cam 29, a valve operating circuit is completed from wire 79 through wire 81, wire 93, movable contact 43, stationary contact 44, wire 94, contact 14, switch arm 73, wire 95, solenoid 12, and wire 96 to wire 80 to energize the solenoid 13 to open the valve 12 to allow gas to flow from some source (not shown) into the gas fired oven (not shown).

Since the cams 27, 28, and 29 are the same as those cams of the modification shown in Fig. 1, and as they may be moved to angular positions, the sequence of operation of this modification is the same as the sequence of operation of the preceding modification, and, therefore, a complete description of the operation of this device is not considered necessary. In passing, it is sufficient to point out that upon closing of the switch 76 the motor 11 is energized to operate the exhaust fan 10, and the starting circuit described above is completed to energize the field coil 22 to rotate the rotor 23 of the timing motor, and consequently to rotate the cams 27, 28, and 29. Upon the first increment of movement, contacts 37 and 38 are closed and the motor holding circuit above described to maintain the field coil 22 of the timing motor energized.

Upon further movement of the cams 27, 28, and 29 contacts 43 and 44 are separated by the cam 29, and upon a still further movement of the cam 48 and 41 are brought into engagement by the cam 29 to complete a timing starting circuit above described to energize the coil 56 to move the switch arm 70 out of engagement with the contact 72 and into engagement with the contact 71 and to move the switch arm 73 into engagement with the contact 74. Movement of the switch arm 70 into engagement with the contact 71 completes the timing holding circuit outlined above to maintain the coil 56 energized, but the movement of the switch arms 70 and 73 into engagement with the contact 74 has no effect because at this time the contacts 43 and 44 are separated by the cam 29.

Upon a further relatively large movement as determined by the length of the high dwell of the cam 29, contact 43 engages contact 44 to complete the valve operating circuit above described to energize the solenoid 13 to open the valve 12 to permit the flow of gas into the gas fired oven. Upon a further movement of the cams to the position shown in Fig. 2, which total movement amounts to substantially 360°, cam follower 35 engages the low dwell 32 of the cam 27 to separate contacts 37 and 38 to break the motor holding circuit to stop further rotation of the timing motor, and consequently the cams 27, 28, and 29. Since at this position contacts 43 and 44 are in engagement, the solenoid 13 will still be energized to maintain the valve 12 open.

Upon power failure, relay coil 56 will become deenergized to permit movement of switch arms 70 and 73 out of engagement with contacts 71 and 74, respectively, and to move switch arm 70 into engagement with contact 72. By such movement caused by power failure as reflected in the deenergization of the relay coil the holding circuit and the valve operating circuit are opened so that upon resumption of power in the lines 76 and 77 the solenoid 13 may not be energized to open the valve 12; therefore, a complete recycle which necessarily requires a complete time interval to elapse between the starting of the fan 10 and the opening of the valve 12 must be had.

From the above it is seen that I have invented a time control mechanism for closing a circuit a predetermined length of time after the closing of another circuit in which power failure protection is afforded in that if the power fails at any time during the timing cycle a complete recycle must be made before the second circuit or external load circuit can be closed. It will also be seen that I have invented a control system for a gas fired oven which requires the exhaust fan thereof to be opened in the same relative time interval as before gas may be supplied to the oven and in which by no manner whatsoever may gas be supplied to the gas fired oven before this predetermined time has elapsed even though power failure and other conditions may come into play to tend to decrease this time interval.

While several embodiments of this invention 75...
have been shown and described, it is obvious that many modifications may be apparent to those skilled in the art; for example, the push button switch and the cut-out switch may be eliminated from the form shown in Fig. 1 and may be properly inserted in the form shown in Fig. 2 without altering the scope of this invention. Consequently, this invention is to be limited only by the scope of the appended claims and the prior art.

I claim as my invention:

1. In a system of the character described, a device to be operated following the lapse of a substantial time interval, timing means, mechanism placed in operation by the timing means to start a timing cycle, and means controlled by the timing means and the mechanism for placing the device in operation a substantial time after the starting of the timing cycle.

2. In a system of the character described, a device to be operated following the lapse of a substantial time interval, timing means, mechanism placed in operation by the timing means to start a timing cycle, means controlled by the timing means and the mechanism for placing the device in operation a substantial time after the starting of the timing cycle.

3. In a system of the character described, a device to be operated following the lapse of a substantial time interval, timing means, mechanism placed in operation by the timing means to start a timing cycle, means for preventing operation of the device in case said mechanism becomes inoperative during the timing cycle whereby the lapse of a complete timing cycle is required to place the device in operation.

4. In a system of the character described, a device to be operated following the lapse of a substantial time interval, timing means, mechanism placed in operation by the timing means to start a timing cycle, means for maintaining the mechanism in operation during the timing cycle, means controlled by the timing means and the mechanism for placing the device in operation a substantial time after the starting of the timing cycle.

5. In a system of the character described, a device to be placed in operation following the lapse of a substantial time interval, timing means, means for placing the timing means in operation, means controlled by the timing means for continuing the timing means in operation, mechanism placed in operation by the timing means to start a timing cycle, means controlled by the timing means and the mechanism for placing the device in operation a substantial time after the starting of the timing cycle and thereby terminating the timing cycle, and means controlled by the timing means and the mechanism for placing the device in operation a substantial time after the starting of the timing cycle.

6. In a system of the character described, a device to be placed in operation following the lapse of a substantial time interval, timing means, means for placing the timing means in operation, means controlled by the timing means for continuing the timing means in operation, mechanism placed in operation by the timing means to start a timing cycle, means for preventing the mechanism in operation during the timing cycle, and means controlled by the timing means and the mechanism for placing the device in operation a substantial time after the starting of the timing cycle.
switch operated by the timing means a substantial
5 time after operation of the first switch to
10 complete a circuit through the coil for the first switch operated
by the coil for placing the device in operation.

12. In a system for placing a first device in
operation and then a second device in operation
following the lapse of a substantial time interval,
the combination of timing means, means for plac-
ing the first device and the timing means in op-
eration, a coil, a switch operated thereby, a first
switch operated by the timing means to complete
an energizing circuit for the coil for closing its
associated switch, and a second switch operated
by the timing means a substantial time after op-
eration of the first switch to complete a circuit
through the switch operated by the coil for plac-
ing the second device in operation.

13. In a timing device of the character de-
scribed, a device to be operated, a motor, tim-
ing means operated by said motor, means com-
pleting a circuit to operate said motor, a coil, a
pair of switches operated thereby, means oper-
ated by said timing means momentarily to com-
plete a first circuit through said coil to close said
20 switches, a second circuit completed through said
coil and one of said switches to maintain said
switches closed after opening of said first circuit
through said coil, and means operated by said
timing means to close a circuit through the other
30 of said switches to operate said device a prede-
termined time after the closing of said switches.

14. In a timing device of the character de-
scribed, a device to be operated, a motor, tim-
ing means operated by said motor, means com-
pleting a circuit to operate said motor, a coil, a
pair of switches operated thereby, means oper-
ated by said timing means momentarily to com-
plete a first circuit through said coil to close said
switches, a second circuit completed through said
coil and one of said switches to maintain said
switches closed after opening of said first cir-
cuit through said coil, means operated by said
timing means to close a circuit through the other
of said switches to operate said device a prede-
termined time after the closing of said switches,
and means for opening said switches upon a fall-
ing of current flow through said coil.

15. In a timing device of the character de-
scribed, a device to be operated, a motor, timing
means operated by said motor, means com-
pleting a circuit to operate said motor, a coil, a
pair of switches operated thereby, means operated by
said timing means momentarily to complete a
first circuit through said coil to close said
switches, a second circuit completed through said
coil and one of said switches to maintain said
switches closed after opening of said first circuit
through said coil, and means operated by said
timing means to close a circuit through the other
of said switches to operate said device a prede-
termined time after the closing of said switches,
and means for opening said switches upon power
failure to prevent operation of said device and
requiring a complete recycle upon resumption of
power to operate said device.

16. In a timing device of the character de-
scribed, a device to be operated, a motor, timing
means operated by said motor, means com-
pleting a circuit to start said motor, means operated by
said timing means to complete a motor holding
circuit to maintain said motor in operation dur-
ing said timing cycle, a coil, a pair of switches
operated thereby, means operated by said timing
means to complete a first circuit through said
coil to close said switches, a second circuit com-
pleted through said coil and one of said switches
to maintain said switches closed after opening
of said first circuit through said coil, and means
operated by said timing means to close a circuit
through the other of said switches to place said
device in operation a predetermined time after
the closing of said switches.

17. In a timing device of the character de-
scribed, a device to be operated, a motor, timing
means operated by said motor, means com-
pleting a circuit to start said motor, means operated
by said timing means to complete a motor holding
circuit to maintain said motor in operation during
said timing cycle, a coil, a pair of switches oper-
ated thereby, means operated by said timing
means to complete a first circuit through said
col to close said switches, a second circuit com-
pleted through said coil and one of said switches
to maintain said switches closed after opening of
said first circuit through said coil, means oper-
ated by said timing means to close a circuit
through the other of said switches to place said
device in operation a predetermined time after
the closing of said switches, and means for open-
ing said switches upon power failure whereby
a complete recycle is required upon resumption
of power to place said device in operation.

20. In a timing system of the class described,
the combination of a valve, a fan, means for oper-
ating the fan, timing means, means for placing the timing
means in operation, mechanism controlled by the timing
means and the means for operating the exhaust
fan, means controlled by the timing means, the
mechanism for opening the gas valve a predeter-
mined time after the timing means is placed
in operation, said mechanism preventing open-
ing of the gas valve if the operating means for
the exhaust fan is not operative.

21. In an oven having a plurality of devices
for controlling the operation thereof, the com-
bination of timing means, means for placing
the timing means and one of the devices in oper-
ation, mechanism controlled by the timing means,
means controlled by the timing means and the
mechanism for placing the other device in opera-
tion a predetermined time after the first device
is placed in operation, and means associating said
mechanism with the first device to prevent opera-
tion of the second device if the operating means
for the first device is not operative.

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