

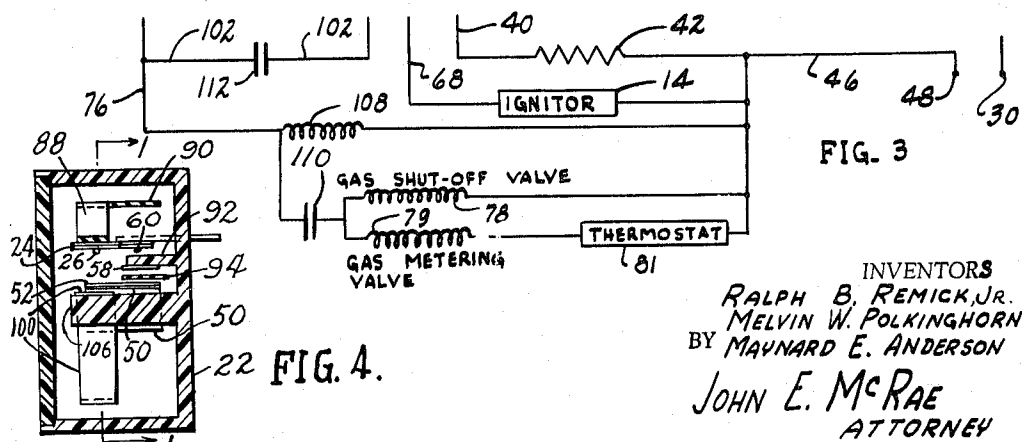
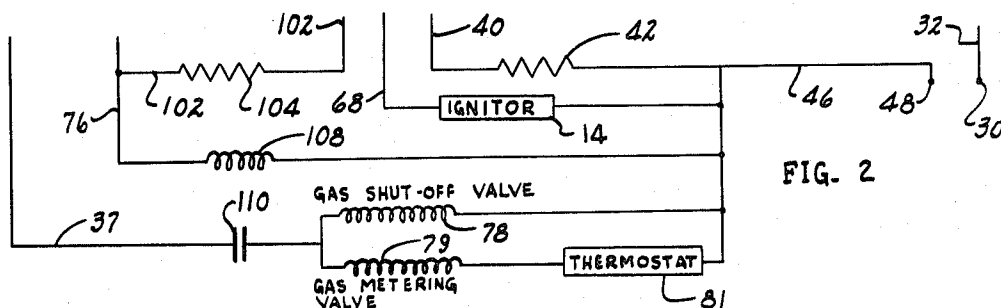
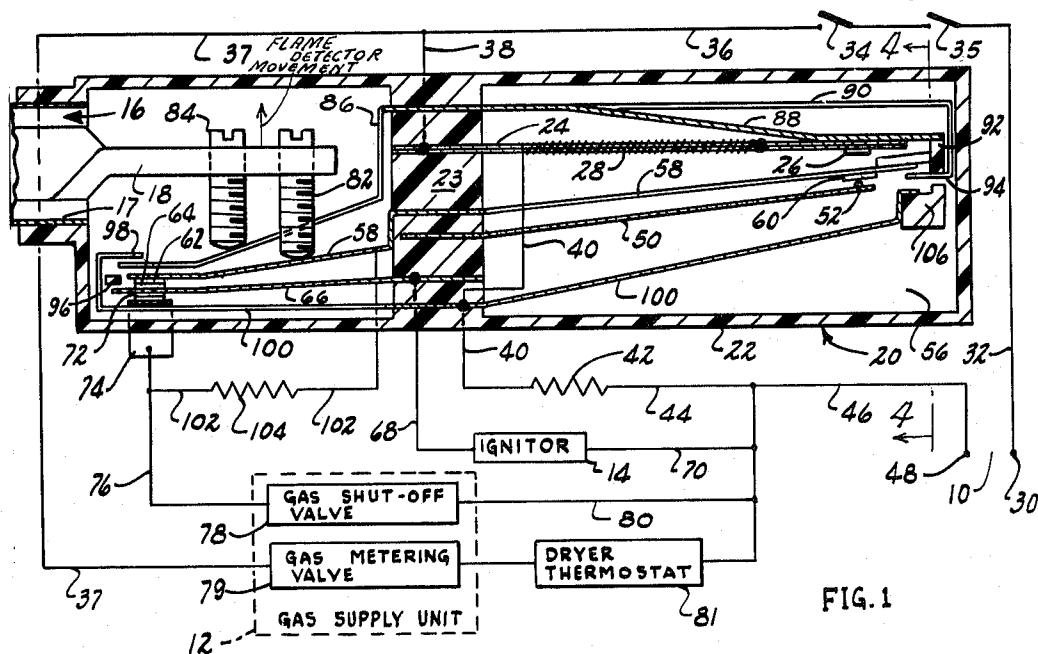
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GAS BURNER IGNITION SYSTEM

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3,249,146

GAS BURNER IGNITION SYSTEM

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This invention relates to an ignition system for a gas burner. It is particularly applicable to use in gas-fired domestic clothes dryers.

One object of the invention is to provide an ignition system in which the gas is ignited electrically rather than by means of a pilot flame.

An additional object is to provide an ignition system which operates on normal household current without a transformer, thus reducing costs.

A further object is to provide an ignition system which operates with a minimum number of relays, thus further reducing costs.

Other objects of this invention will appear from the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

In the drawings:

FIGURE 1 is a view, semi-diagrammatic in nature and partly taken in section on line 1-1 in FIG. 4, illustrating one form of the invention;

FIG. 2 is a diagrammatic view illustrating an arrangement of circuit components which can be utilized in lieu of certain components shown in FIG. 1;

FIG. 3 is another diagrammatic view illustrating another arrangement of circuit components which can be used in lieu of certain components shown in FIG. 1;

FIG. 4 is a sectional view taken substantially along line 4-4 in FIG. 1.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

General description of the system

FIG. 1 of the drawings shows an ignition system for a gas burner comprising an electric igniter 14, an electrically-operated gas supply unit 12, a flame detector 16, and an electric timer 20.

Timer 20 has the function of controlling the gas supply unit 12 and igniter 14 in accordance with different conditions which may prevail at the burner or in the electrical system. In a typical cycle, when the start switches 34 and 35 are closed timer 20 feeds electric current to gas supply unit 12 and igniter 14 for a time normally sufficient to establish a flame at the burner. If a flame is established flame detector 16 causes the timer to automatically de-energize the igniter without disturbing gas supply unit 12. If the igniter fails to establish a flame the timer automatically de-energizes both the igniter and gas valve.

After the establishment of flame inadvertent extinguishment of the flame is sensed by detector 16. In operation, the detector forces timer 20 to put the igniter and gas supply valve through one ignition attempt. If the attempt fails the igniter and gas valve are de-energized;

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if the attempt succeeds the igniter is de-energized and the gas supply unit is left undisturbed, as on a normal cycle.

In the event of momentary electric current failure timer 20 immediately de-energizes the gas supply unit and then puts the igniter and gas supply valve through one ignition attempt, as in the case of flame failure.

Normally the cycle is completed by opening switch 34 and/or switch 35. When the gas burner is used in a domestic clothes dryer switch 34 takes the form of a manually settable time-operated device, and switch 35 takes the form of a switch operable by opening and closing the clothes dryer door.

In the practice of our invention the ignitor is preferably a chattering relay as shown for example in U.S. Patent 2,076,418. Flame detector 16 preferably comprises a warpable tubular element as shown for example in U.S. Patent 2,418,867.

Gas supply unit 12 may be constructed as shown in pending U.S. patent application, Serial No. 314,407, filed October 7, 1963; it comprises a main shut-off valve operated by solenoid 78 and a metering valve operated by solenoid 79. When solenoid 78 alone is energized the gas supply unit delivers small gas quantities to the burner, as for example three cubic feet per hour. When solenoids 78 and 79 are both energized the gas supply unit delivers larger gas quantities to the burner as for example 37 cubic feet per hour. When solenoid 78 is de-energized the flow of gas to the burner is completely interrupted.

A normally closed dryer thermostat 81 is arranged in series with solenoid 79 to energize the metering valve until the dryer operating temperature is reached. During start-up periods solenoids 78 and 79 are both energized to cause unit 12 to deliver large fuel quantities to the burner. When the operating temperature is reached solenoid 79 is de-energized by thermostat 81, thus reducing the fuel flow until thermostat 81 again calls for increased heat. During the burner operating period solenoid 78 is energized continuously, and solenoid 79 is cycled on and off in accordance with the heating demand on the clothes dryer.

Timer 20

Timer 20 comprises an elongated dielectric casing 22 having a central partition 23 which mounts six leaf-like current conductors. The six leaf-like conductors are identified by the numerals 86, 24, 58, 50, 66, and 100. Conductor 24 is a bimetallic thermostatic element which receives all of the current passing through the timer; conductor 24 functions as the master control element for the timer. Conductor 58 serves to direct current from conductor 24 to gas supply solenoid 78 and igniter 14 in accordance with the condition of flame detector 16. Element 50 serves as a spring for imposing an upward force on conductor 58 and also as a current connection between elements 24 and 58. Element 86 functions as a device for short-circuiting and de-energizing the bimetal heater 28 after the heater has warped the bimetal into an operating normal run position. Element 100 functions as a device for short-circuiting the bimetal heater 28 when the bimetal has been warped into a lock-out position, as on flame failure.

Flame establishment

Beginning with the conductors in the FIG. 1 cold position, heat is applied to bimetal conductor 24 by means of a resistance wire heater 28 which is wrapped about the bimetallic element. The heater receives its supply of current through a circuit which includes source terminal 30, line 32, switches 34 and 35, lines 36 and 38, bimetal 24, the heater, line 40, load resistor 42, lines 44 and 46, and source terminal 48.

Bimetal 24 carries a longitudinally extending contact pin 26 which registers with a transverse contact pin 52

welded to the free end of leaf 50. As bimetal 24 is heated by heater 28 it warps downwardly to cause its contact pin 26 to engage the contact pin 52. The motion of bimetal 24 is thereby transmitted to leaf 50. Di-electric case 22 is provided with a fixed abutment 92 which extends forwardly from rear wall 56 an insufficient distance to interfere with downward movement of bimetal element 24. In this regard it should be noted that the portion of bimetal 24 to the right of heater 28 is cut away behind the illustrated portion to enable the bimetal to clear leaf 58 and abutment 92 during its downward movement.

Each contact 26, 60 or 52 is an elongated pin or wire. Pins 26 and 60 have their axes parallel to the plane of the paper (FIG. 1), while pin 52 has its axis at right angles to the plane of the paper. During an ignition attempt bimetal leaf 24 is warped downwardly by heater 28 so that its pin 26 moves past leaf 58 which is in back of the right end portion of leaf 24. In this manner pin 26 is caused to engage pin 52.

Leaf 58 is disposed in the rear portion of casing 22 in a position normally engaged with fixed abutment 92. Leaf 58 is weakly biased in a downward direction, and leaf 50 is strongly biased in an upward direction so that contact 52 on leaf 50 is normally engaged with longitudinally extending contact pin 60 carried on leaf 58. During the downward motion of bimetal leaf 24 contact pin 26 strikes contact pin 52; due to its downward bias leaf 58 moves downwardly with the two leaves 24 and 50. A circuit is thus established from leaf 24, through contacts 52 and 60, to the leaf 58.

As shown in the drawing, leaf 58 extends leftwardly through partition 23 to conduct current to its contact 62 and a contact 64 carried on current-conducting leaf 66. A line 68 leads the current from leaf 66 to the igniter 14 and eventually back to the source terminal 48.

Current for gas supply solenoid 78 is initially supplied through a circuit comprising leaf 58, contacts 62 and 64, leaf 66, contact 72, terminal 74, line 76, the solenoid, and lines 80 and 46. With solenoid 78 and igniter 14 both energized a flame should be established at the burner.

It should be noted that within a few seconds after the armature for solenoid 78 has been moved to the energized position a relatively small current is sufficient to hold it in such a position. To supply this holding current there is provided a line 102 having a resistor 104 therein. The resistance value of resistor 104 is chosen so that line 102 is ineffective to energize the solenoid during the initial energization period but is effective to maintain the solenoid energized during the holding period.

Normal run operation

The term "normal run operation" refers to the condition which prevails when a flame is established and the burner is operating to heat the surrounding atmosphere.

The presence of burner flame is detected by the flame detector 16, which includes a heat warpable tube 17 and an elongated actuator bar 18. In practice flame detector tube 17 extends from casing 22 alongside the burner so that one of its side surfaces is subjected directly to the burner flame. The free end of tube 17 is secured to the elongated actuator 18 which extends through the tube and into casing 22 as shown in FIG. 1. Upon the establishment of a flame the side surface of tube 17 nearest the flame becomes hotter than the other side surface, with a consequent warpage of the tube. Such warpage is relied upon to cause an upward movement of actuator 18.

Actuator 18 is provided with two force-applying elements illustrated as adjustable screws 82 and 84. Screw 82 registers with the left portion of an upwardly biased section of leaf 58, and screw 84 registers with the left portion of an upwardly biased section of leaf 86. The subjacent leaf 66 is upwardly biased and carries a contact 72 which normally engages terminal 74. As a result,

within a few seconds after flame establishment actuator 18 moves upwardly to enable leaf 86 to engage portion 98 of leaf 100 and contact 72 to separate from terminal 74. As leaf 66 moves upwardly it strikes abutment 96 to effect separation of contacts 62 and 64.

During the normal run period leaf 86 is engaged with portion 98 of leaf 100, leaf 58 is operatively separated from leaf 66, and leaf 66 is operatively separated from terminal 74.

Leaf 86 comprises a central portion mounted in partition 23 and two rightwardly extending sections 88 and 90. Leaf section 88 extends in front of section 90 and includes an end portion which normally rests against fixed stop 92 formed integrally with casing 22. Section 88 is provided as a means for preventing an ignition attempt in the event that the flame detector is for any reason out of its normal start position at the initiation of the attempt. Thus, if the flame detector is in a hot position wherein the left end of leaf 86 is engaged with leaf portion 98 then heater 28 will be short-circuited through a circuit comprising bimetal 24, section 88, the left portion of leaf 86, leaf 100, line 40, resistor 42, and lines 44 and 46. The heater will therefore remain de-energized and there will be no ignition attempt.

Leaf section 90 includes a reversely turned end portion 94 which registers with the free end of leaf 58. During downward movement of bimetal 24 leaf 58 strikes reversely turned end portion 94, and heater 28 is thereby short-circuited through a circuit which comprises line 38, bimetal 24, contacts 26, 52 and 60, the right end area of leaf 58, leaf sections 94 and 90, the left portion of leaf 86, leaf portion 98, the remaining left portion of leaf 100, line 40, resistor 42, and lines 44 and 46. As the heater is short-circuited and thus de-energized, bimetal 24 cools and warps upwardly so that leaf 58 lifts off of leaf portion 94. The heater is thus re-energized to again heat the bimetal.

During the normal run period bimetal 24 warps back and forth with continual engagement between contacts 26, 52 and 60. Leaf 58 enjoys back and forth movement, alternately engaging and disengaging leaf portion 94. Leaf portion 94 has some slight movement to and from abutment 92.

Failure to initially establish flame

During the ignition attempt igniter 14 and solenoid 78 continue to receive current as long as leaf 58 functions as a current conductor. Current is supplied to leaf 58 as long as contact 60 engages contact 52. As bimetal 24 warps downwardly leaf 58 strikes leaf portion 94; if flame is not established leaf 86 remains in the illustrated cold position disengaged from leaf portion 98. Heater 28 therefore continues to remain energized, and bimetal 24 continues its downward warping movement to enable leaf 58 to move leaf section 90 downwardly until halted by abutment 106, whereupon contacts 52 and 60 separate. Leaf 58 is then deprived of current, with consequent de-energization of igniter 14 and solenoid 78.

Heater 28 continues to be energized through line 40, and bimetal 24 continues to move downwardly until the free end of the bimetal engages the tip of current conductor 100. When this occurs the heater is short-circuited through a circuit which includes bimetal 24, conductor 100, line 40, resistor 42, and lines 44 and 46. As the bimetal cools it moves upwardly away from conductor 100 to permit a re-energization of heater 28 and a consequent heating of the bimetal. The bimetal thus moves back toward conductor 100. This back and forth movement of bimetal 24 permanently locks out the igniter 14 and solenoid 78, and prevents further ignition attempts.

Flame failure during normal run operation

During the normal run period actuator 18 is in a raised condition, the left portion of leaf 86 is engaged with leaf

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portion 98, the left portion of leaf 58 is operatively disengaged from leaf 66, and leaf 66 is operatively disengaged from terminal 74. Bimetal 24 is undergoing alternate heating and cooling by heater 28, leaf 58 is alternately engaged with and disengaged from leaf portion 94, and leaves 50 and 58 are moving back and forth with bimetal 24. Igniter 14 is de-energized, and solenoid 78 is energized through a circuit which includes resistor 104.

In the event of flame failure actuator 18 moves to its illustrated position in which an energizing circuit is provided for the igniter through leaf 58, contacts 62 and 64, leaf 66, line 68, the igniter, and lines 70 and 46. If the igniter and solenoid 78 successfully produce a flame the actuator 18 will move upwardly, as during normal flame establishment. If the igniter and solenoid are not able to establish a flame bimetal 24 will proceed downwardly to the lockout position previously described.

At the instant of flame failure bimetal 24 will be effecting a back and forth movement of leaf 58 to and from leaf portion 94. As soon as the flame detector reaches the cold position, the next contact between leaf 58 and leaf portion 94 produces no short-circuiting of the heater, as during the normal run period (because the short-circuit is now open at 98). Instead heater 28 continues to be energized to warp bimetal 24 downwardly toward the lock-out position. During movement toward the lock-out position an energizing circuit is maintained for solenoid 78 through leaf 58, contacts 62 and 64, leaf 66, contact 72, terminal 74, line 76, the solenoid, and lines 80 and 46. The igniter is energized through leaves 58 and 66. In the lock-out position contact 60 is separated from contact 52, and the igniter and solenoid are therefore de-energized.

Momentary current failure during the normal run period

The illustrated system is designed to produce one attempt at ignition in the event of momentary current failure, whether the failure is due to interruption of the power supply or rapid opening and closing of the dryer door switch 35.

As previously explained, during the normal running period leaf 58 is alternately engaged with and disengaged from leaf portion 94, and gas supply solenoid 78 is energized through a circuit comprising resistor 104. In the event of momentary current failure bimetal 24 warps upwardly so that contact 26 separates from contact 52. No current is being delivered to leaf 58, and valve solenoid 78 is therefore de-energized; actuator 18 thus moves downwardly to its illustrated cold position.

As soon as the current again begins to flow through line 38 element 24 begins its downward warping movement, as during an initial attempt at ignition. If the attempt is successful the bimetal assumes its normal run position. If the attempt is unsuccessful the bimetal proceeds to its lock-out position engaged with the tip of leaf 100.

FIG. 2 embodiment

The partially illustrated circuit in FIG. 2 is intended to be utilized with the timer 20 shown in FIG. 1, and similar reference numerals are applied to the corresponding circuit components.

The FIG. 2 circuitry differs from the FIG. 1 circuitry primarily in the fact that solenoids 78 and 79 are both supplied with current through a line 37 which does not proceed from the timer terminal 74. However the FIG. 2 embodiment is similar to the FIG. 1 embodiment in that current flow through line 37 is controlled by a relay which is energized through a line 76 leading from the timer. In FIG. 2 the relay comprises a coil 108 and a set of normally open contacts 110. Whenever timer 20 supplies current to line 76 relay 108 is energized to close the normally open contacts 110, thus energizing solenoids 78 and 79.

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The operation of the FIG. 2 embodiment is in other respects similar to that of the FIG. 1 embodiment.

FIG. 3 embodiment

This embodiment is also intended to utilize the FIG. 1 timer, and corresponding reference numerals are therefore applied to similar circuit components.

The FIG. 3 embodiment utilizes a relay having a coil 108 and two sets of normally open contacts 110 and 112. Contacts 112 serve in lieu of the resistor 104 used in the FIG. 1 and FIG. 2 embodiments. During the periods when timer 20 supplies current to line 76 relay coil 108 closes contacts 110 and 112 to energize the two gas valve solenoids 78 and 79. The general operation is similar to that of the FIG. 1 embodiment.

The FIG. 1 embodiment is less costly than the FIG. 2 and FIG. 3 embodiments in the elimination of relay coil 108 and contacts 110 and 112. The FIG. 3 embodiment may however be preferred in some instances since it does not require a resistance 104 calibrated in accordance with the power requirements of solenoid 78.

Each embodiment of the invention is advantageous in the elimination of a transformer and multiple relays such as are sometimes employed in electric ignition systems.

What is claimed:

1. An electric ignition system for a gas burner comprising an electric igniter, an electric gas valve, a flame detector, and an electric timer;

said timer comprising a heater and a thermostatic leaf warpable thereby between an off position, a flame-establishing position, a normal run position, and a lock-out position; a current-carrier leaf movable by the thermostatic leaf, means connected with the current carrier leaf to direct current to the gas valve and igniter when the thermostatic leaf is in the flame establishing position, and means operable to de-energize the gas valve and igniter when the thermostatic leaf is in the lock-out position; said flame detector including means operable in response to the establishment of flame to de-energize the igniter without disturbing the gas valve;

said timer including a short-circuit leaf movable by the flame detector and having means operably connected therewith to temporarily de-energize the heater and thereby maintain the thermostatic leaf in its normal run position after a flame has been established.

2. An electric ignition system for a gas burner comprising an electric igniter, an electric gas valve, a flame detector, and an electric timer;

said timer comprising a current-conducting thermostatic leaf having a first contact carried thereon; an electric heater arranged adjacent said thermostatic leaf to warp same between an off position, a flame-establishing position, a normal run position, and a lock-out position; a second leaf strongly biased toward the first leaf and having a second contact in registry with the first contact; a third leaf including a first leaf section disposed between the first and second leaves and weakly biased toward the second leaf, a second section in registry with the flame detector to derive movement therefrom upon the establishment of a flame, and a third contact carried on the first section of the third leaf in registry with the second contact; a fourth leaf having a first section in registry with the first section of the third leaf, and a second section in registry with the flame detector to derive movement therefrom; a fifth leaf having a first section in registry with the thermostatic leaf, and a second section in registry with the second section of the fourth leaf; and a sixth leaf registering with the second section of the third leaf; said igniter being permanently connected with the sixth leaf, and said gas valve having interruptible connections with the third leaf and the sixth leaf,

whereby energization of the heater warps the thermostatic leaf to effect engagement between the first, second and third contacts, whereupon current is delivered through the third leaf to the gas supply valve and igniter, and

in the event of successful ignition the flame detector separates the second section of the third leaf from the sixth leaf, and engages the second section of the fourth leaf with the second section of the fifth leaf, whereupon the heater is short-circuited through a circuit comprising the thermostatic leaf, first, second and third contacts, a portion of the third leaf, and the fourth and fifth leaves, and

in the event of flame extinguishment the flame detector disconnects the fourth and fifth leaves, thereby permitting the heater to warp the thermostatic leaf into a lock-out position engaged with the first section of the fifth leaf.

3. An electric ignition system for a gas burner comprising an electric igniter, an electric gas valve, a flame detector and an electric timer;

said timer comprising a current-conducting thermostatic leaf having a first contact carried thereon; an electric heater arranged adjacent said thermostatic leaf to warp same between an off position, a flame-establishing position, a normal run position, and a lock-out position; a second leaf biased toward the first leaf and having a second contact in registry with the first contact; a third valve energizing and igniter energizing leaf including a first leaf section disposed between the first and second leaves, a second section in registry with the flame detector to derive movement therefrom upon the establishment of a flame, and a third contact carried on the first section of the third leaf in registry with the second contact; a fourth leaf having a first section in registry with the first section of the third leaf, and a second section in registry with the flame detector to derive movement therefrom; a fifth leaf having a first section in registry with the thermostatic leaf, and a second section in registry with the second section of the fourth leaf; and a sixth leaf registering with the second section of the third leaf; said igniter being permanently connected with the sixth leaf, and said gas valve having interruptable connections with the third leaf and the sixth leaf.

4. An electric ignition system for a gas burner comprising an electric igniter, an electric gas valve, and an electric timer; said timer comprising a thermostatic leaf and an electric heater operable when energized to warp said leaf from an off position to a lock-out position; said timer including circuit components for energizing the heater to cause the thermostatic leaf to move from its off position to a flame-establishing position in which the valve and igniter are energized; said timer having circuit components for intermittently energizing the heater to cause the thermostatic leaf to have a first normal run vibrating mode of movement in which the igniter is de-energized and the valve is energized; said timer having circuit components for energizing the heater in response to flame failure to put the timer through an ignition attempt in which both the gas valve and igniter are energized; said timer further having circuit components for de-energizing the heater as the thermostatic leaf reaches its lock-out position, whereby the leaf enjoys a second vibrating mode of movement when in its lock-out condition.

5. An electric ignition system for a gas burner comprising an electric igniter, an electric gas valve, and an electric timer; said timer comprising a thermostatic leaf and an electric heater operable when energized to warp said leaf from an off position to a lock-out position; said timer including control circuitry acting through the heater to cause the thermostatic leaf to move from its off position to a flame establishing position, and to then take a vibratory normal run mode of movement in which the

gas valve is energized and the igniter is de-energized; said timer including control circuitry acting through the heater to cause the thermostatic leaf to proceed from its normal run vibratory mode toward a vibratory lock-out mode in which both the gas valve and igniter are de-energized.

6. An electric ignition system for a gas burner comprising an electric igniter, an electric gas valve, and an electric timer; said timer comprising first circuit means operable to energize the igniter and gas valve for a predetermined time period to establish a flame at the burner; said timer further comprising second circuit means operable to energize the gas valve and de energize the igniter after establishment of a flame; said timer further comprising circuit means automatically operable in response to flame failure to energize both the gas valve and igniter for a predetermined time period in an attempt to re-establish the flame; said timer further comprising circuit means automatically operable to de-energize both the gas valve and igniter in the event the attempt to re-establish flame is unsuccessful.

7. An electric ignition system for a gas burner comprising an electric igniter, an electric gas valve, a flame detector, and an electric timer; said timer comprising a thermostatic leaf and an electric heater operable to warp same from an off position to a lock-out position; said timer further comprising an igniter energizer circuit, a valve energizer circuit, a heater energizer circuit, a first heater short circuit, and a second heater short circuit; said igniter energizer circuit comprising the thermostatic leaf, a second spring leaf strongly biased toward the thermostatic leaf and having an electrical contact in registry therewith, and a third spring leaf weakly biased toward the second leaf and having an electrical contact registering therewith; said first heater short circuit including the thermostatic leaf, the second spring leaf, the third spring leaf, a fourth spring leaf having a portion thereof registering with the third spring leaf to be electrically connected therewith upon a predetermined warping movement of the thermostatic leaf, said fourth spring leaf having a second portion thereof registering with the flame detector to short circuit the heater when the detector senses flame failure; said second heater short circuit comprising a fifth leaf having a portion thereof registering with the bimetal and engageable therewith when said thermostatic leaf reaches a lock out position beyond its normal run range of movement.

8. An electric timer comprising a support structure; a first thermostatic leaf mounted on said support structure and having a first contact carried thereon; a heater carried by said thermostatic leaf and operable to warp same; a second spring leaf mounted on said support structure and strongly biased toward the thermostatic leaf, said second leaf having a second contact in registry with the first contact; a third leaf mounted on said support structure between the first and second leaves and weakly biased toward the second leaf, said third leaf having a third contact engageable with the second contact but out of registry with the first contact; a fourth heater short circuit leaf mounted on said support structure and having a portion thereof registering with a portion of the third leaf, whereby the heater will warp the thermostatic leaf to cause the first contact to engage the second contact, whereupon the second and third leaves will be carried with the thermostatic leaf until the third leaf engages the registering portion of the fourth leaf; said first, second and third contacts being located in the energization circuit of the heater, whereby engagement of the third leaf with the registering portion of the fourth leaf will effect a short circuit of the heater.

9. An electric ignition system for a gas burner comprising an electric igniter, an electric gas valve, and an electric timer; said timer comprising a support structure; a first thermostatic bimetal leaf mounted on said support structure and having a first contact thereon; a bimetal heater carried on said bimetal for effecting warping move-

ment thereof; a second spring leaf mounted on said support structure and strongly biased toward the thermostatic leaf, said second leaf having a second contact in registry with the first contact; a third spring leaf mounted on said support structure between the first and second leaves, and weakly biased toward the second leaf, said third leaf having a third contact in registry with the second contact, but out of registry with the first contact, whereby warping movement of the first leaf by the heater causes the first contact to engage the second contact, thus deflecting the second leaf, but permitting the third leaf to have its third contact in engagement with the second contact as the second leaf is deflected by the thermostatic leaf.

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