April 22, 1969 G. H. FATHAUER 3,439,991

DRYER CONTROL

Filed Jan. 20, 1967

Fig-1

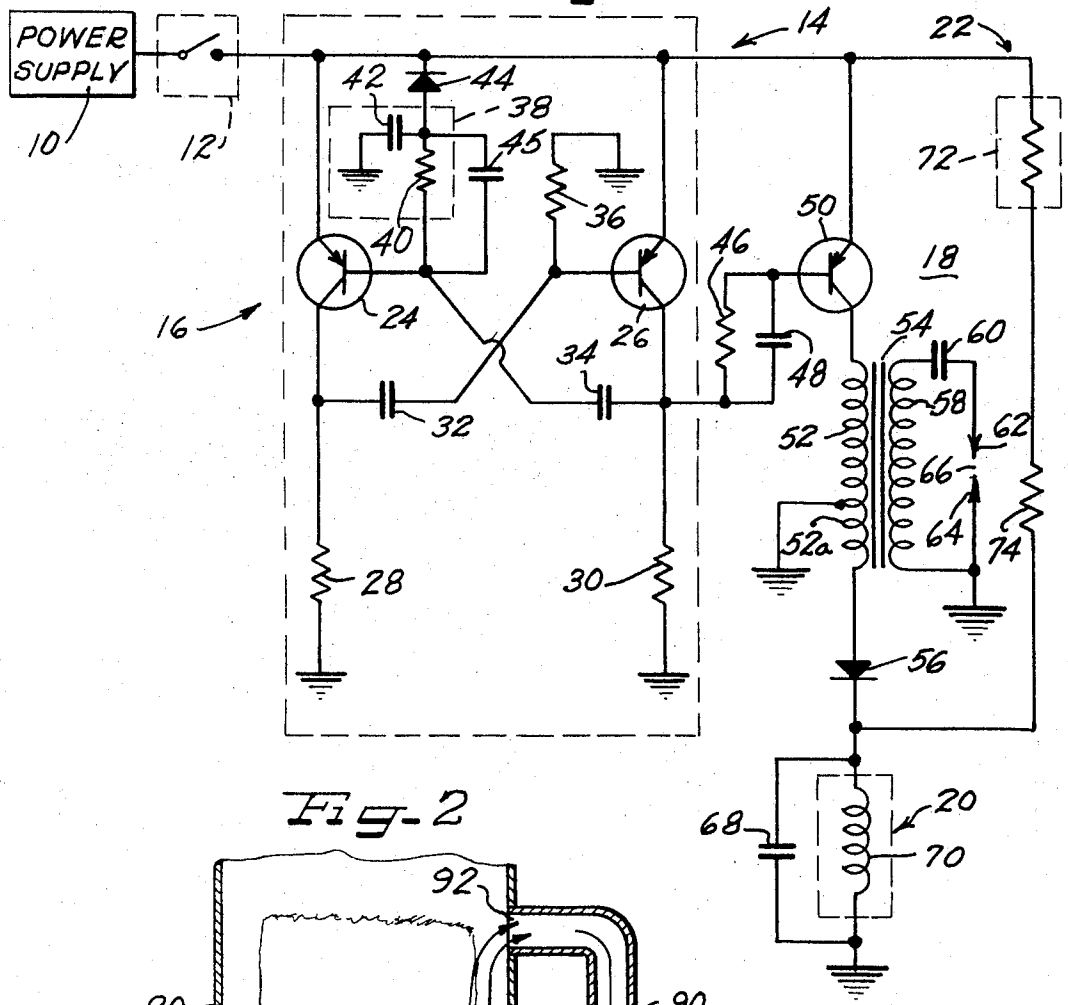
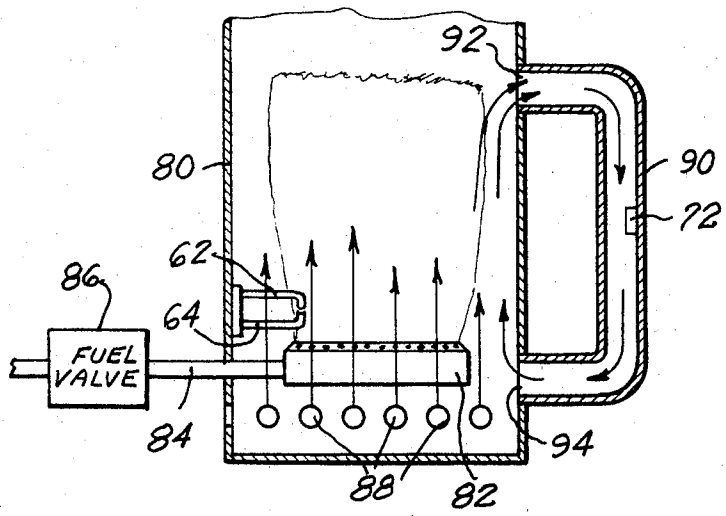


Fig-2



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DRYER CONTROL

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ABSTRACT OF THE DISCLOSURE

A control circuit for a burner employing an oscillator having a fixed operating time, a transformer connected to an output of the oscillator to produce a high voltage discharge across a pair of igniter electrodes, a fuel valve actuator connected to an output of the oscillator, and a thermistor connected between a source of voltage and the fuel valve actuator. The thermistor is dimensioned to provide holding current only for the fuel valve actuator after it has been initially actuated by the oscillator output and only if the temperature of the burner is sufficiently high at the termination of the output signal from the oscillator.

Background of the invention

Field of the invention.—This invention relates generally to a burner control circuit and more particularly to a circuit for simultaneously controlling the ignition of fuel within a burner and the flow of fuel thereto, and subsequently either maintaining or discontinuing the flow of fuel depending upon the temperature conditions within the burner. The present invention has specific application in a gas dryer machine.

Description of the prior art.—Burner controls are relatively old in the art, per se, including those of the electrical or electronic type. However, some of the prior art control devices employ a separate circuit for the igniter and a separate and independent circuit for controlling the fuel valve. For instance, many of such prior art controls employ a manually operable switch which must be depressed for a predetermined time, during which time the igniter is operated and the fuel valve is actuated. In those circuits, the fuel valve is usually controlled after initial actuation thereof by the manually operable switch in response to a temperature within the burner. However, initial actuation of the fuel valve is not automatic and is entirely within the control of an operator.

In those circuits which require the manual actuation of a switch by an operator, in order to provide a completely hazardous free operation, a timer must be employed with the manually operable switch so that only a metered amount of fuel will be supplied to the burner. Without such a timer, an operator may continue to supply fuel to the burner by maintaining the manually operable switch closed. It is therefore possible, without a timer in circuit with the switch, to deliver a greater quantity of fuel to the burner than that desired and to produce a hazardous condition thereby.

The provision of separate circuits for the igniter and the fuel valve of a burner and the requirement of a timer, of course, increases the cost of such burner controls. In addition, in those prior art controls which employ a manually operable switch, an operator must maintain the switch actuated for a predetermined time. As a result, an unsafe condition may be created through neglect of the operator.

Summary of the invention

It is, therefore, an object of the present invention to provide a burner control circuit which employs a single source of excitation for controlling the ignition of fuel within a burner and for controlling the flow of fuel thereto.

It is another object of the present invention to provide a burner control circuit which simultaneously controls the ignition of a fuel within a burner and the flow of fuel thereto, and subsequently either maintains or discontinues the flow of fuel depending upon the temperature conditions within the burner.

Still another object of the present invention is to provide a burner control circuit which is not dependent upon an operator's judgment nor subject to an operator's negligence.

Accordingly, the present invention provides a single source of excitation current for an igniter and for a fuel control valve and further provides means responsive to the temperature within the burner for maintaining the fuel valve actuated after it has been initially actuated by the excitation source and only if the tempearture of the burner is sufficiently high.

An important feature of the present invention resides in the provision of a single source of excitation current for controlling the igniter and the fuel valve for a burner, which excitation source has a fixed operating time.

Another important feature of the present invention resides in the provision of a circuit element which is responsive to the temperature of the burner for maintaining the fuel valve actuated after it has been initially actuated by the excitation source and only if the temperature of the burner is sufficiently high.

Brief description of the drawing

These and other objects, features and advantages of the present invention will be more fully realized and understood from the following detailed description when taken in conjunction with the accompanying drawing wherein:

FIGURE 1 is a schematic diagram of a control circuit constructed in accordance with the principles of the present invention; and

FIGURE 2 is a diagrammatic view in section of a burner which may be employed in conjunction with the control circuit illustrated in FIGURE 1.

Like reference numerals throughout the various views of the drawing are intended to designate the same or similar structures.

Description of the preferred embodiment

With reference to FIGURE 1, there is illustrated a circuit diagram of the control circuit constructed in accordance with the principles of the present invention. As shown therein, a power supply **10** supplies direct current voltage through a switch **12** to the control circuit, generally designated with the reference numeral **14**. The switch **12** may be an on-off switch, a thermostat, or any device intended to initiate the operation of a burner.

The control circuit **14** generally includes an excitation source, designated with the reference numeral **16**, a high voltage section, generally designated with the reference numeral **18**, a fuel valve actuator generally designated with the reference numeral **20**, and a fuel valve actuator hold-in circuit, generally designated with the reference numeral **22**.

The excitation source **16** is illustrated in FIGURE 1 in the form of a multivibrator which produces a series of pulses at an output thereof. In particular, the multivibrator includes a pair of transistors **24** and **26** having their emitters connected to the source of direct current voltage and their collectors connected through resistors **28** and **30** respectively to ground potential. The collector of the transistor **24** is coupled to the base of the transistor **26** by a capacitor **32** and the collector of the transistor **26** is coupled to the base of the transistor **24** by a capacitor **34**. The base of the transistor **26** is connected to ground potential through a resistor **36** and the base of the transistor **24** is connected through a circuit **38** to ground potential.

In particular, the circuit **38** includes a resistor **40** and a capacitor **42** which are connected in series with one another between the base of the transistor **24** and ground potential. A junction between the resistor **40** and the capacitor **42** is connected to the DC voltage source through a diode **44**. In addition, a capacitor **45** is connected in parallel to the resistor **40**. The capacitor **32**, the capacitor **34**, the resistor **36**, the capacitor **45**, and circuit **38** determine the period of oscillation of the multivibrator circuit. However, the circuit **38** is constructed to continually increase the time between successive pulses at an output of the multivibrator.

Upon initial application of the DC source of voltage to the multivibrator or oscillator circuit, a series of pulses will appear at an output thereof. These pulses coupled through the capacitor **34** will develop a charge on the capacitor **42** which will gradaully increase as the multivibrator continues to provide an output. As the charge on the capacitor **42** increases, the time between successive pulses at an output of the multivibrator will also increase until the charge on the capacitor **42** reaches a predetermined level to maintain the transistor **24** nonconductive and cause the oscillatory action on the multivibrator to cease. As a result, the output from the multivibrator will be discontinued when the capacitor **42** has been charged to the required level.

During the time that the DC voltage is applied to the multivibrator through the switching device **12**, the diode **44** is back-biased and will not permit the capacitor **42** to discharge. In addition, after the capacitor **42** has been charged to the predetermined level, the transistor **26** is maintained in a conductive state causing the junction point of the capacitor **34** and resistor **30** to be maintained substantially at the level of the DC voltage. This condition will also retain the charge on the capacitor **42** and will not permit it to become discharged. However, when the DC voltage is removed from the multivibrator by opening the switching device **12**, the capacitor **42** will be discharged through the diode **44**. Preferably, the values of the resistor **40** and capacitor **42** are dimensioned to develop the required charge on the capacitor **42** in approximately thirty seconds.

An output of the multivibrator is connected through a resistor **46** and a capacitor **48** in parallel with one another to the base of a transistor **50**. The circuit including the resistor **46** and capacitor **48** matches the multivibrator output power to the transistor **50**. The transistor **50** performs as a switching device in the circuit. In particular, the emitter of the transistor **50** is connected to the source of direct current voltage **10** through the switching device **12** and the collector thereof is connected to one end of a primary winding **52** of a high voltage transformer **54**. A tap of the primary winding **52** is connected to ground potential and the other end thereof is connected through a diode **56** to the fuel valve actuator **20**. The transformer **54** includes a secondary winding **58** which is connected on one seide thereof through a capacitor **60** to to a first igniter electrode **62** and on the other side thereof to a second igniter electrode **64**. The electrode **64** is connected to ground potential. The igniter electrodes **62** and **64** are disposed in spaced relationship with respect to one another to define a voltage discharge gap **66** therebetween.

When an output is being delivered from the multivibrator, negative-going pulses render the transistor **50** conductive to provide a current flow from the source of direct current voltage through a portion of the primary winding **52** to ground potential. A positive-going pulse from the multivibrator **16** renders the transistor nonconductive and the resultant rapid decay of current through the primary winding **52** develops a relatively large potential across the secondary winding **58** and a voltage discharge across the gap **66**. At the same time, a voltage is developed in a winding portion **52***a* of the primary winding **52** which supplies a current through the diode rectifier **56** and to the fuel value actuator **20**. A capacitor **68** is connected across the fuel valve actuator **20** and performs to filter the alternating current pulses supplied thereto and to develop a substantially direct current voltage across the fuel valve actuator **20**. The fuel valve actuator **20** is illustrated in the drawing as a solenoid **70**. The capacitor **60** in series with the igniter electrodes **62** and **64** limits the power supplied to the igniter gap **66** so that sufficient current will be developed in the winding portion **52***a* to permit the fuel valve actuator **20** to be energized.

A thermistor **72** is connected to the source of direct current voltage and also through a resistor **74** to the fuel valve actuator **20**. The thermistor **72** is mounted in heat communication with the burner and is dimensioned to provide hold-in current for the fuel valve actuator **20** after the actuator has been initially energized by the remaining circuitry and only if it is raised to a predetermined temperature. The resistor **74** in series with the thermistor **72** reduces self heating of the thermistor. Preferably, the thermistor **72** must be heated to a temperature of approximately 300° F. before it will conduct sufficient current to hold the fuel valve actuator **20** energized. However, if the fuel valve actuator **20** is not initially energized, conduction of current through the thermistor **72**, regardless of its temperature, will not independently energize the fuel valve actuator **20**. Preferably, the time constant circuit of the multivibrator **16** including the resistor **40** and the capacitor **42** is matched to the heating time of the thermistor **72**. Therefore, the fuel valve actuator **20** is energized only when the multivibrator **16** is generating an output. Since less current is required to maintain the fuel valve actuator **20** energized, the thermistor **72** will maintain the actuator **20** energized if sufficient heat is reflected thereto.

It can be readily appreciated that the circuit performs the following functions automatically upon closure of the switching device **12**:

(1) Energization of the fuel ignition circuit;

(2) Energization of the fuel valve actuator; and

(3) Maintain the fuel valve actuator energized if ignition has occurred or deenergize the same if proper ignition has not occurred.

FIGURE 2 illustrates a feature of the present invention which permits the use of a less expensive thermistor in the circuit illustrated in FIGURE 1. In particular, a burner housing, generally designated with the reference numeral **80** supports a burner **82** therein which is supplied with fuel from a conduit **84** having a fuel valve **86** therein. The fuel valve **86** is controlled by the fuel valve actuator **20** to control the supply of fuel to the burner **82**. The burner housing **80** includes a plurality of air inlets **88** which permit the passage of air to the burner to be heated. The igniter electrodes **62** and **64** are mounted on a wall of the burner housing **80** adjacent the burner **82**. In addition, a bypass or a recirculation conduit **90** extends between an opening **92** in an upper portion of the housing **80** and an opening **94** in the lower portion of the housing **80**. The thermistor **72** is mounted within the recirculation conduit **90**. Heated air passes through the conduit **90** as indicated by the arrows in FIGURE 2 and supplies heat to the thermistor **72** when proper ignition

of the fuel has taken place. Consequently, the thermistor **72** may not be located directly in or adjacent the flame and, consequently, is not subjected to relatively high temperatures. Therefore, a less expensive thermistor can be employed in the circuit illustrated in FIGURE 1.

The circuit illustrated in FIGURE 1 was operated successfully with the circuit elements dimensioned as follows:

R28	ohms	2.2K
R30	do	180
R36	do	4.7K
R40	do	27K
R46	do	100
R74	do	510
C32	microfarads	0.047
C34	do	0.068
C42	do	250
C45	do	0.047
C48	do	1.0
C60	picofarads	27.0
C68	microfarads	25
Winding **52** (including *52a*)	turns	210
Winding *52a*	do	70
Winding **58**	do	10,000
Power supply **10**	volts	15

The drawings and specification present a detailed disclosure of the preferred embodiments of the invention, and it is to be understood that the invention is not limited to the specific forms disclosed, but covers all modifications, changes and alternative constructions and methods falling within the scope of the principles taught by the invention.

I claim:

1. A control circuit for a fuel valve and an igniter of a burner, comprising:

(a) means for producing a control signal of predetermined time duration, said control signal producing means including a multivibrator having at least one time determining circuit for controlling the time period of successive pulses of said control signal at an output thereof, said time determining circuit including means responsive to the lapsed operating time of said multivibrator for rendering said multivibrator inoperative after said predetermined time duration,

(b) means responsive to said control signal for producing a voltage discharge at the igniter,

(c) means responsive to said control signal for actuating the fuel valve, and

(d) means responsive to a predetermined level of temperature within the burner for maintaining the fuel valve actuated after initial actuation thereof by said actuating means.

2. A control circuit as defined in claim **1**, wherein said voltage discharge producing means includes a transformer having a primary winding connected to an output of said multivibrator and a secondary winding connected to the igniter.

3. A control circuit as defined in claim **1**, further comprising means for initiating operation of said control signal producing means.

4. A control circuit as defined in claim **1**, wherein said rendering means includes a capacitor and means for supplying successive pulses of said control signal to said capacitor for developing a charge thereon proportioned to the number of pulses supplied thereto.

5. A control circuit as defined in claim **4**, wherein said multivibrator includes at least one transistor having a base electrode connected to said capacitor.

6. A control circuit as defined in claim **1**, wherein said voltage discharge producing means includes a transformer having a primary winding connected to said control signal producing means and a secondary winding connected to the igniter, and wherein said actuating means includes a further winding on said transformer and a solenoid disposed for actuating the fuel valve and connected to said further winding.

7. A control circuit as defined in claim **6**, further comprising a rectifier connected in series between said further winding and said solenoid.

8. A control circuit as defined in claim **7**, further comprising a capacitor connected across said solenoid.

9. A control circuit as defined in claim **1**, wherein said maintaining means includes a thermistor.

10. A control circuit as defined in claim **9**, wherein the burner includes a recirculation conduit, and wherein said thermistor is mounted in said recirculation conduit.

11. A control circuit as defined in claim **1**, further comprising a source of direct current potential, and wherein said voltage discharge producing means includes a switching device and a transformer having a primary winding and a secondary winding, said switching device being connected for actuation thereof to said control signal producing means and between said source of direct current potential and said primary winding, said secondary winding being connected to the igniter, whereby a voltage discharge results in the ignitor as a result of a rapid decay of current in said primary winding in response to said switching device.

12. In combination with a burner, a valve for supplying fuel to the burner, and igniter electrodes disposed for igniting the fuel at the burner, a control circuit, comprising:

(a) means for producing a series of pulses for a predetermined time,

(b) means for producing a voltage discharge across the igniter electrodes in response to said series of pulses,

(c) means responsive to the temperature of the burner for developing a control current having a magnitude proportional to the temperature, and

(d) means for actuating the valve in response to said series of pulses and for maintaining the valve actuated only in response to a predetermined magnitude of said control current.

13. In combination with a burner, a valve for supplying fuel to the burner, and igniter electrodes for igniting the fuel at the burner, a control circuit comprising:

(a) a multivibrator having an output in the form of a series of pulses and having circuit means controlling the time duration of said series of pulses,

(b) a transformer having a primary winding connected to said output and a first secondary winding connected to the igniter electrodes,

(c) a fuel valve actuator mechanically connected to the valve, said transformer having a second secondary winding connected to said actuator,

(d) a source of voltage, and

(e) a thermistor disposed in heat communication with the burner and connected between said source of voltage and said actuator.

14. A combination as defined in claim **13**, further comprising a switching device having a switching control element, said output being connected to said control element and said switching device being connected between said source of voltage and said primary winding.

15. A combination as defined in claim **14**, further comprising a rectifier connected between said second secondary winding and said actuator.

16. A combination as defined in claim **15**, further comprising a capacitor connected across said actuator.

17. A combination as defined in claim **13**, wherein said multivibrator includes a pair of transistors each having an emitter electrode, a collector electrode and a base electrode, a pair of resistors, said emitter electrode and said collector electrode of each of said transistors being connected in series with a respective one of said resistors between said source of voltage and a reference potential, a first capacitor connected between the base of one of said

transistors and a junction of one of said resistors with the other of said transistors, a second capacitor connected between the base of said other transistor and a junction of the other of said resistors with said one transistor, a third resistor connected between the base of said other transistor and said reference potential, and a fourth resistor and a third capacitor connected in series with one another between the base of said one transistor and said reference potential.

18. A combination as defined in claim **17**, further comprising a rectifier connected from a junction of said fourth resistor with said third capacitor to said source of voltage.

19. A combination as defined in claim **18**, further comprising a fourth capacitor connected across said fourth resistor.

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