Dec. 14, 1965 D. R. GRAHL 3,223,137

OIL BURNER CONTROL

Filed Jan. 28, 1963

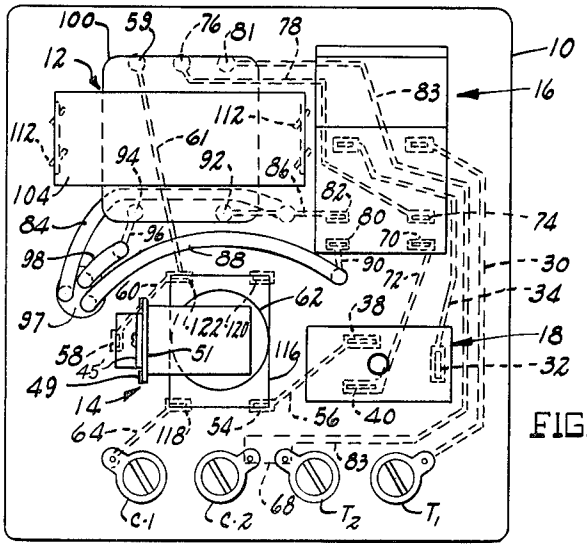


FIG_1

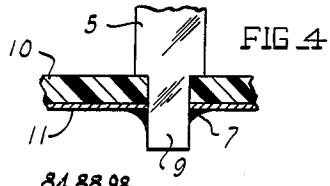


FIG_4

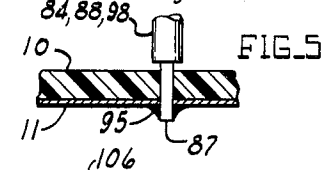


FIG_5

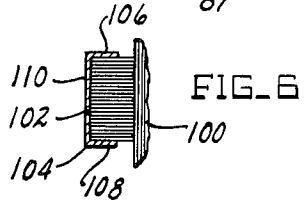


FIG_6

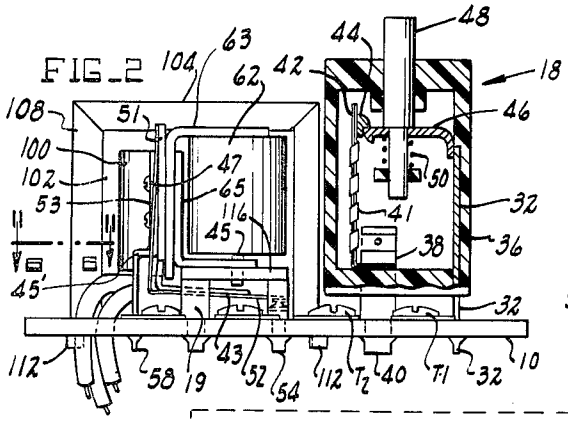


FIG_2

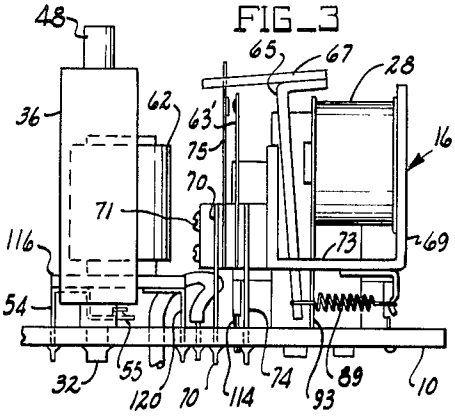


FIG_3

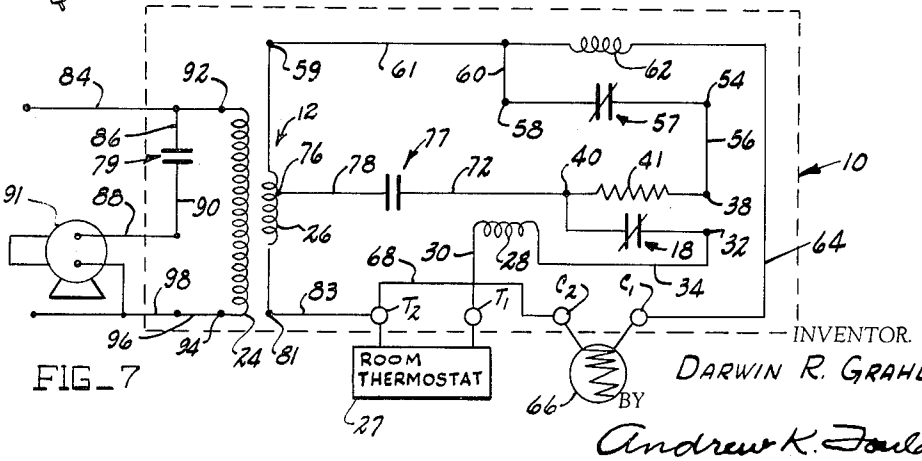


FIG_7

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OIL BURNER CONTROL

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4 Claims. (Cl. 158—28)

This invention relates to an oil burner control which operates the burner in response to a call for heat by a room thermostat, and which provides a secondary control circuit so that if the burner fails to properly ignite the burner will be de-energized without undergoing additional unsuccessful attempts at ignition. The secondary control circuit is provided with a manual reset means so that after an unsuccessful attempt at ignition manual resetting of the burner control is required before ignition can again be attempted.

Oil burner controls have in the past included several component devices such as a step down transformer, two or more relays, a manual reset switch, and various flexible lead wires for connecting the components to each other within the control casing. The control casing is usually a relatively small box-like affair of limited volume, as for example four inches or less on a side. Due to the cramped quarters within such small casing volumes the steps involved in wiring up the control have in the past been tedious, time-consuming, and subject to error.

With the above in mind, it is a principal object of this invention to provide an oil burner control having a reduced number of electrical and mechanical connections within the control casing.

As related to the above, it is a further object to provide an oil burner control which utilizes printed circuits.

A still further object is to provide an oil burner control having a di-electric panel, one face of which accommodates the control components and the other face of which has printed circuitry thereon, the control components having electric terminals projecting through the di-electric panel to soldered connections with the printed circuits, whereby all of the electrical connections can be made on the face of the panel which is unencumbered by the control components.

A further object of the invention is to provide an oil burner control wherein the electrical components are mounted on a di-electric panel by means of spade-like elements which constitute both mechanical mounting devices and electrical connectors, thus enabling the assembler to mechanically mount and electrically connect the components in single step operations.

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 top plan view of an oil burner control construction according to my invention;

FIG. 2 is a front elevational view of the FIG. 1 structure, with certain parts thereof broken away for illustration purposes;

FIG. 3 is a right elevational view of the FIG. 1 structure;

FIG. 4 is an enlarged fragmentary sectional view illustrating a connection used in the FIG. 1 embodiment;

FIG. 5 is an enlarged fragmentary sectional view illustrating another connection used in the FIG. 1 embodiment;

FIG. 6 is a fragmentary sectional view taken on line 6—6 in FIG. 2; and

FIG. 7 is a circuit diagram for the structure of 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.

Referring to FIGS. 1 through 6 of the drawings, there is shown an oil burner control having a di-electric base or panel **10** for mounting a transformer **12**, a first relay **14**, a second relay **16**, and a manual reset switch **18**. Each of the transformer, relays **14** and **16**, and switch **18** have electrical connector elements which project through slots in panel **10**. As best shown in FIG. 4, a representative one of the connector elements comprises a spade-like element **5** having a reduced width section **9** extending beyond the lower surface of panel **10** so as to have a soldered connection **7** with parts of printed circuitry generally designated by numeral **11**. Thus, the projecting portions of the connectors are adapted to be soldered directly to the printed circuitry for thereby acting as electrical connectors and also as mechanical mounting devices for the operating components such as the two relays and reset switch.

FIGS. 1 through 3 show a burner control of this invention, while FIG. 7 shows diagrammatically the relation of the control to the other components in an oil burner environment. As shown in FIG. 7, transformer **12** is provided with a primary **24** and a secondary **26**. Terminals T_1 and T_2 on panel **10** are arranged to connect with a room thermostat **27** as is conventional, and terminal T_1 is arranged to be connected with the coil **28** of relay **16**, as by means of a printed circuit line **30**. The other side of coil **28** connects with a printed circuit line **34** which leads to the terminal **32** of switch **18**.

The construction of switch **18** may be varied as to detail, but as shown semi-schematically in FIG. 2 the switch comprises a di-electric case **36** which is provided with the three spade-type terminals **32**, **38** and **40**. Each terminal may be formed as shown in FIG. 4, whereby the three terminals extend through panel **10** and serve as the sole mounting means for case **36**. Terminal **38** is electrically connected with a resistance heater **41** which is wrapped about bimetal **42** and which is adapted to have its lower end electrically connected with terminal **40**, not shown in the cutaway portion of FIG. 2. The upper end of the bimetal registers with switch arm **46**. The switch arm is floatably positioned on a manually actuable push-button **48**, as by means of a compression spring **50**.

In operation of switch **18**, when heater **41** is energized bimetal **42** slowly warps to the left to disengage detent **44** from switch arm **46** to thereby permit spring **50** to snap arm **46** upwardly out of engagement with terminal **32**. This interrupts the circuit between terminals **32** and **40**, and prevents arm **46** from moving down toward terminal **32** except after manual depression of button **48**. After bimetal **42** has cooled to warp back to its illustrated position pushbutton **48** can be manually depressed to operate arm **46** to the illustrated latched position.

Returning again to FIGS. 1 and 7, terminal **38** is connected with switch terminal **54** of the relay **14** by printed circuit line **56**. The cooperating switch terminal **58** of the relay is connected with terminal **59** of the transformer secondary by means of printed circuit lines **60** and **61**, and the coil portion **62** of the relay is connected with terminal C_1 by means of a printed circuit line **64**. Terminals **54** and **58** form part of a switch designated generally by numeral **57** in FIG. 7.

Terminals C_1 and C_2 are adapted to connect with a flame sensing control device shown diagrammatically in FIG. 7 as a cadmium sulphide cell **66**. The connection

between terminals C_2 and T_2 is effected through a short printed circuit connector **68**, which in the FIG. 1 embodiment is merely a large blob of solder. As shown in FIG. **1**, circuit connector **68** is located at one end of a printed circuit line **83** which leads to the terminal **81** on the secondary of the transformer.

Still referring to FIGS. 1 and 7, terminal **40** connects with printed circuit line **72** which leads to a terminal **70** constituting part of the switch portion **77** of the relay **16**. The other terminal **74** of this switch portion is connected to terminal **76** of the transformer secondary by means of a printed circuit line **78**.

Relay **16** is provided wtih a second switch **79** having two additional switch terminals numbered **80** and **82**. Terminal **82** connects with a short printed line **86** which forms a juncture with an insulated flexible conductor **84**. Terminal **82** connects with a printed line **90** which forms a juncture with another flexible insulated conductor **88**. Printed circuit line **86** also extends over to the transformer terminal **92**. The other terminal **94** of the transformer primary connects with a printed circuit line **96** which connects with the flexible insulated conductor **98**.

The control is shown in FIG. 7 in a de-energized condition wherein switches **18** and **57** are closed, and switches **77** and **79** are open; room thermostat **27** is de-energized. On the call for room heat by room thermostat **27** current is supplied from the transformer secondary **26** through a circuit which includes line **83**, terminal T_2, room thermostat **27**, terminal T_1, line **30**, coil **28**, line **34**, switch **18**, heater **41**, line **56**, switch **57**, and lines **60** and **61**. As coil **28** is energized it closes switches **77** and **79** so that switch **79** is able to energize the oil burner **91** in the conventional manner. The purpose of switch **77** during this period is to provide a holding circuit for maintaining coil **28** energized even though current should later stop flowing through heater **41** and switch **57**.

If the burner is able to successfully ignite, flame responsive switch **66** closes so that a circuit is completed through line **83**, terminal T_2, line **68**, terminal C_2, switch **66**, terminal C_1, line **64**, coil **62**, and line **61**. Coil **62** is thereby energized to open switch **57** and thus prevent heater **41** from opening switch **18**. Therefore if a flame is successfully established coil **28** remains energized to complete a circuit through switch **79**.

If the burner does not successfully establish or maintain a flame, switch **66** remains in an open condition and no current flows through coil **62**. Under this circumstance heater **41** causes bimetal **42** to warp to the left (FIG. 2) for thus opening switch **18**. By this action coil **28** is de-energized and switch **79** is thereby opened to thus discontinue current flow to the burner. Failure of the control to establish or maintain a flame causes switch arm **46** to snap upwardly and thus require manual resetting of button **48** to return the switch to its FIG. 2 position.

Referring now to the individual control components, transformer **12** comprises a coil **100** and a laminated rectangular core **102** which is encased in a metal frame **104** of generally U-shaped configuration (as seen in FIG. 2). The frame is of sheet metal construction and has flanges **106** and **108** which overlie the faces of the transformer core. The main wall portion **110** of the frame has spade-like extensions **112** which extend downwardly through slots in panel **10** and which are preferably twisted as shown in FIG. 1 to rigidly retain the transformer assembly on the panel. As best seen in FIG. 3, the terminals for the transformer comprise wire elements **114** which extend downwardly from molded parts of the transformer coil through openings in panel **10** and which are soldered to the printed circuitry in the manner generally shown in FIG. 5.

Referring now to relay **14**, said relay includes a rectangular di-electric platform **116** having downwardly extending metal leg elements **118**, **54**, **120** and **122** at its four corners. Each of the four metal leg elements is provided with a reduced width extension similar to extension **9** shown in FIG. 4, and each of these extensions has solder applied thereto to mechanically and electrically mount the relay on panel **10**.

As best shown in FIG. 3, leg **54** is provided with a lateral extension **55** which carries one of the contacts for switch **57**. This contact is arranged to be engaged by a contact on the superjacent portion **52** of a resilient L-shaped member **53**. The upwardly extending portion of resilient member **53** comprises two spaced strips **49** which are soldered to a metal plate **51** to form an electrical connection therewith. The plate **51** is clamped in place by means of a bracket **45'** and screws **47**. The lower extremity of bracket **45'** extends through panel **10** and forms the aforementioned terminal **58**.

Coil portion **62** of relay **14** is energized from terminals which are designated in FIG. 1 by numerals **118** and **122**. These terminals take the form of L-shaped metal legs similar in shape to leg **120** shown in FIG. 3. The horizontal portions of these legs connect with lead wires from coil **62**, and the lower extremities of these legs project through panel **10** to soldered connections with the printed circuitry as shown generally in FIG. 4. The three legs **54**, **118** and **122** serve both as electrical connectors and as mechanical mounting devices for platform **116**. Leg **120** serves only as a mounting device for the platform.

Coil portion **62** of the relay is disposed within a U-shaped frame comprised of two L-shaped plates **63** and **65** which may be carried jointly by platform **116** and bracket **45'**. As shown in FIG. 2, the armature for the relay comprises a plate **43** having a hinged connection with plate **51** and having a fixed connection with the horizontal portion of resilient element **53**. Thus the resilient element tends to hold armature **43** in its illustrated lowered position when coil **62** is de-energized. When the coil is energized the armature **43** is drawn upwardly toward core **45** to thus break the circuit between elements **54** and **58**.

Relay **16** comprises a U-shaped frame **69** having one flange thereof clamped onto a stack of interposed insulators and conductors by screws **71**. Mechanical support for the frame is provided by four stiff metallic spade elements **70**, **74**, **80** and **82** (see FIG. 1) which have reduced width extensions projecting through slots in panel **10** so as to have soldered connections with printed circuitry **11** in the manner illustrated in FIG. 4.

The relay further comprises an armature **65'** which is pivotally mounted on frame wall **73** and which carries a di-electric plate **67**. A transverse slot is provided in plate **67** for accommodating the upper end portions of certain reed-like switch arms, one of which is designated by numeral **75** in FIG. 3. Cooperating with reed **75** is a second reed-like arm **63'**. Two other switch arms are disposed behind arms **63'**, and **75**, and are thus not visible in that figure. It will be understood that switch arms **75** and **63'** are electrically engaged with spade elements **70** and **74**, and that the other two switch arms are electrically engaged with the other two spade elements **80** and **82**. Such an arrangement provides the two switches designated by numerals **77** and **79** in FIG. 7.

In operation of relay **16**, when coil **28** is de-energized a tension spring **89** holds armature **65** in its illustrated position wherein the two relay switches are open; when coil **28** is energized by terminal members **93** armature **65** is drawn to the right so as to close the two relay switches. The noteworthy feature of relay **16** is that it is mounted on panel **10** solely by means of the four spade elements **70**, **74**, **80** and **82** which serve additionally as electrical connectors. The relay can be fabricated separately from panel **10** and be installed thereon in a simple one-step operation which does not involve connecting hard-to-reach flexible conductors.

The only flexible conductors used in the FIG. 1 construction are conductors **88**, **98** and **84**. Each of these conductors may be connected into the printed circuitry

by having the conductive wire portion **87** thereof extend downwardly through an opening in panel **10** so as to have a soldered connection **95** with the printed circuitry **11**. A large opening **97** may be formed in panel **10** to accommodate the three flexible conductors.

Although not shown in the drawing, in practice a rectangular housing may be provided on each face of panel **10** to house the operating components and to isolate the printed circuitry from adjacent structure. The housing for the operating components preferably does not overlie the four terminals C_1, C_2, T_1 and T_2 so that these terminals are freely accessible for connection with the lead wires from thermostat **27** and flame switch **66**.

A primary feature of the invention resides in the construction and positional relationship of the four main components **12**, **14**, **16** and **18** on one face of panel **10**, with each of said components having electrical conductor elements extending through openings in the panel to soldered connections with the printed circuitry. In the case of components **14**, **16** and **18** the conductor elements are of sufficient rigidity as to constitute devices for mechanically mounting the components on the panel.

What I claim is as follows:

1. A burner control comprising a step down transformer having a primary circuit connected with the burner and a secondary circuit comprising a room thermostat, a flame-responsive control device, a manual reset switch and heater therefor, a burner-energizer relay, a second relay energized by the flame-responsive control device, and

circuit connections operatively arranged so that initial energization of the room thermostat serves to energize the burner-energizer relay through the reset switch and heater, and establishment of a burner flame causes the second relay to de-energize the heater without de-energizing the burner-energizer relay or reset switch, and the absence of flame causes the second relay to energize the heater and thereby open the reset switch;

each of said transformer, relays, switches, and heater being disposed on one face of a dielectric panel with terminals thereof projecting through the panel; said terminals being operatively connected by means of printed circuit lines on the other face of the panel; said thermostat and flame-responsive control device being located remote from the panel and being connected into the control circuit by means of terminals mounted on the panel in direct connection with the printed circuit lines.

2. A burner control comprising a step down transformer having a primary circuit and a secondary circuit, a room thermostat, a flame-responsive control device, a reset switch and heater, first and second relays including coils and switches controlled thereby, and circuit connections,

whereby energization of the room thermostat serves to energize the coil of the second relay through the reset switch and heater, and establishment of a burner flame causes the coil of the first relay to open its switch and de-energize the heater, and the absence of flame causes the coil of the first relay to close its switch to energize the heater and thus open the reset switch;

each of said transformer, relay coils, switches, and heater being disposed on one face of a dielectric panel with terminals thereof projecting through the panel; said terminals being operatively connected by means of printed circuit lines on the other face of the panel; said thermostat and flame responsive control device being located remote from the panel and being connected into the circuit for the burner control by means of terminals mounted on the panel in direct connection with the printed circuit lines.

3. A burner control comprising a step down transformer having a primary circuit and a secondary circuit;

said secondary circuit comprising a first relay coil and a normally closed switch controlled thereby; a flame-responsive control device controlling the flow of current through said first relay coil; a second relay coil having two normally open switches, one of which is arranged to energize the burner and the other of which constitutes a holding switch; a room thermostat arranged to control current flow through the second relay coil; a normally closed reset switch and a heater for opening said reset switch; said heater and reset switch being in series with one another, and said heater and holding switch being in parallel with one another;

whereby energization of the room thermostat serves to energize the second relay coil through the reset switch and heater, and establishment of a burner flame causes the first relay coil to open its switch and thus de-energize the heater, and the absence of flame causes the first relay coil to close its switch to energize the heater and thus open the reset switch;

each of said transformer, relay coils, switches, and heater being disposed on one face of a dielectric panel with terminals thereof projecting through the panel; said terminals being operatively connected by means of printed circuit lines on the other face of the panel; said thermostat and flame responsive control device being located remote from the panel and being connected into the control circuit by means of terminals mounted on the panel in direct connection with the printed circuit lines.

4. A burner control comprising a step down transformer having a primary circuit and a secondary circuit;

said secondary circuit comprising a winding having two end taps and an intermediate tap, a first control circuit connecting said end taps which includes a normally open flame responsive control device and a first relay coil; a second control circuit connecting one of the end taps and said intermediate tap comprising a room thermostat, a second relay coil, a normally closed reset switch, and a normally open holdng switch controlled by the second relay coil; a third control circuit interconnecting the first and second control circuits comprising a heater for the reset switch and a normally closed switch controlled by the first relay coil;

the transformer primary circuit including a normally open burner-energizer switch controlled by the second relay coil;

whereby energization of the room thermostat serves to energize the second relay coil through the reset switch and heater, and establishment of a burner flame energizes the first relay coil to open its switch and thus de-energize the heater, and the absence of flame de-energizes the first relay coil to close its switch and energize the heater for thus opening the reset switch;

each of said transformer, relay coils, switches, and heater being disposed on one face of a dielectrc panel with terminals thereof projecting through the panel; said terminals being operatively connected by means of printed circuit lines on the other face of the panel; said thermostat and flame responsive control device being located remote from the panel and being connected into the control circuits by means of four terminals mounted on the panel in direct connection with the printed circuit lines.

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