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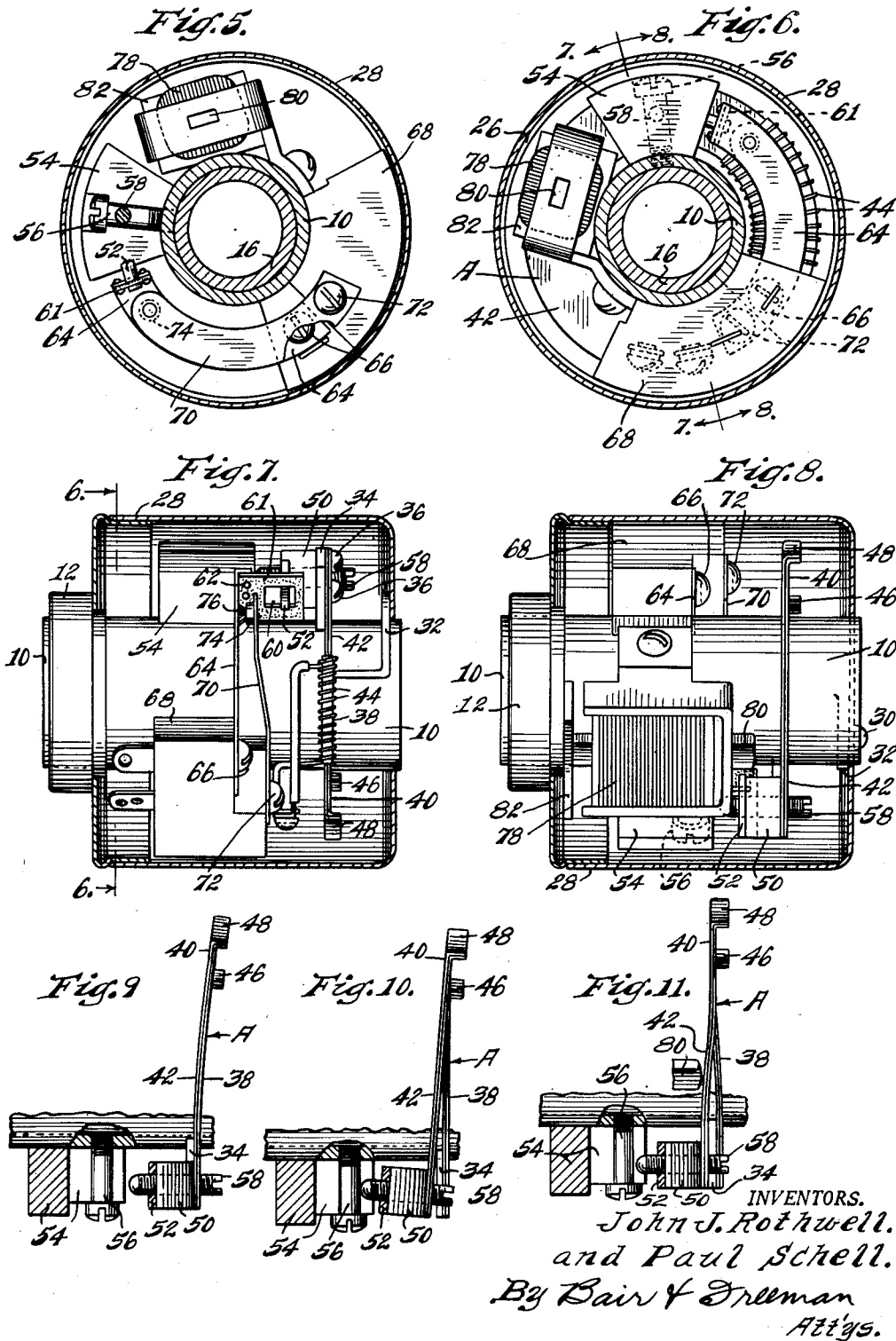
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SAFETY PRIMARY CONTROL FOR BURNERS

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2 SHEETS—SHEET 2



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SAFETY PRIMARY CONTROL FOR BURNERS

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Our present invention relates to an oil burner control or the like wherein a so-called "primary control" is in the form of a unit to be installed on an oil pipe in an oil burner nozzle instead of utilizing the usual "stack switch" as a safety control.

One object of our invention is to provide a combined combustion switch and safety switch incorporated in a single control unit which unit may be connected in a burner control circuit in a simple manner so as to deenergize the relay closed circuit of the motor switch as a result of combustion failure either initially or after establishment.

Another object is to provide a primary control that is simple to manufacture and compact in construction, the control requiring no cutting into the furnace or stack and being designed so that it does not interfere with operation of the usual gun type oil burner when installed within the nozzle thereof.

A further object is to provide a control arranged to respond directly to the heat of combustion by exposing a bimetal element of the control to combustion heat, the bimetal element being located closely adjacent the flame and the control including an electric heater for heating another portion of the bimetal to result in a safety shut-down operation in case of flame failure from any cause.

Still a further object is to provide a bimetal element constructed in such manner that the single element responds to two different conditions: (1) Combustion heat and (2) heat from an electrically energized heater, the parts being associated in a control circuit so that the desired opening of the circuit is had upon combustion failure.

An additional object is to provide a remotely controllable means to reset the primary control in operative position after it has tripped to shut-down position.

Another additional object is to provide the remote controlled resetting mechanism in the form of a resetting device operated by electricity and by a circuit that can extend either to a point adjacent the outside of the furnace or adjacent the room thermostat, the electric circuit being such that whenever the reset coil is energized the room thermostat circuit is opened so that the room thermostat circuit is inoperative at that time, thus preventing possible manual holding of the control circuit in operating position when it should be open for safety purposes.

With these and other objects in view, our in-

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vention consists in the construction, arrangement and combination of the various parts of our device whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in our claims and illustrated in the accompanying drawings, wherein:

Figure 1 is a diagrammatic view showing a burner control circuit to which our primary control is applicable.

Figure 1a is a vertical sectional view through the flame end of a gun type oil burner showing the burner nozzle (or oil pipe and oil nozzle), our primary control being mounted on the oil pipe to the oil nozzle, the three wires leading from the primary control being shown in similar relation to Figure 1.

Figure 2 is an enlarged front elevation of the primary control and shows the oil pipe in cross section taken on the line 2—2 of Figure 1a.

Figure 3 is a vertical sectional view through the housing of the control as taken on the line 3—3 of Figure 2, the part of the control within the housing being shown in side elevation.

Figure 4 is a sectional view on the line 4—4 of Figure 3.

Figure 5 is a sectional view on the line 5—5 of Figure 3.

Figure 6 is a vertical sectional view taken on the line 6—6 of Figure 7.

Figure 7 is a sectional view similar to Figure 3, being taken on the line 7—7 of Figures 2 and 6 and showing the control within the housing in bottom plan elevation.

Figure 8 is a sectional view taken on the line 8—8 of Figure 6 in a direction opposite Figure 7 and showing the control within the housing in plan elevation.

Figure 9 is a sectional view through a snap action magnet taken on the line 9—9 of Figure 4 and showing in conjunction therewith the bimetal element in operating position.

Figure 10 is a similar view showing it in tripped position, and

Figure 11 is a similar view showing the bimetal element in cooled down position and in the act of being reset by the resetting mechanism.

On the accompanying drawings, we have used the reference numeral 10 to indicate a sleeve which serves as a support for our primary control. The sleeve 10 has a hub 12 and a set screw 14. The sleeve 10 is adapted to surround the oil pipe 16 of an oil burner. The pipe 16 as shown in Figure 1a terminates in an oil spray nozzle 18 and the oil pipe is supported along the center of an air tube 20 of a burner.

Air is supplied to the air tube 20 from a blower operated by a blower motor BM in the usual manner commonly known in the oil burner art. The air tube 20 and the nozzle 18 together are usually referred to as a "burner nozzle." The burner just described is of the gun type and oil is sprayed from the nozzle 18 and ignited by suitable electrodes (not shown) receiving high tension current from an electrical ignition mechanism shown diagrammatically in Figure 1 as Ign.

The burner nozzle projects into a combustion chamber of a furnace, the wall of which is shown at 22. This wall is usually lined with refractory 24. Our primary control is adapted to have its sleeve 10 surrounding the oil pipe 16 leading to the oil nozzle 18 and retained in position relative thereto by the set screw 14 at a position a few inches back of the oil spray nozzle 18.

A cup-shaped housing end 26 is secured to the hub 12 and cooperating with it is a cover 28. The cover 28 is adapted to be secured in position by a screw 30 extended through the cover and threaded into a lug 32 extending laterally from the sleeve 10. This cover is provided with an opening 29, the purpose of which will hereinafter appear.

Within the cover 28 we mount a torus-shaped bimetal element A as by anchoring one end to a stationary lug 34 extending from the sleeve 10 by means of screws 36 threaded into the lug. The bimetal element, it will be noted, substantially surrounds the sleeve 10 which makes for compactness of design yet secures considerable length for the bimetal element.

The bimetal element A may be considered as having three sections 38, 40 and 42. The section 38 is the one that is anchored by means of the screws 36. The section 42 may be considered as a combustion responsive section because it is open to the flame at the discharge end of the burner air tube 18 through the opening 29 in the cover 28. This opening is perhaps best shown in Figure 2.

The section 40 of the bimetal element A may be considered as relatively non-warping because of a pair of flanges 46 and 48 formed along its inner and outer edges (see Figure 4). The section 38 of the element A may be considered as a heater section, it being heated by an electric heater 44 comprising a coil wound around the bimetal element. The heater 44 is of resistance wire so that current flow through it produces heat for effecting a warping action on the bimetal element section 38, warping due to temperature rise of the heater being operable to bow the lower end of the bimetal element as shown in Figure 10 toward the right due to the inactive side of the bimetal element being toward the flame through the opening 29. Also the heat of the flame causes warping in a similar direction as will later be described.

Carried by the free end of the bimetal element section 42 is a bracket 50 that supports an armature 52 adjacent a permanent horse-shoe magnet 54. The horse-shoe magnet is secured to the tube 10 by a screw 56 which as shown in Figure 8 serves as a stop for screw 58. The screw 58 is adjustable in relation to the bimetal element A and the armature 52.

The armature 52 extends into a slot 61 of a piece of insulating material secured as by rivets 62 to a leaf spring 64. The leaf spring 64 is anchored by means of a screw 66 to a block of insulation 68 secured to the tube 10 and supported thereby. A second leaf spring 70 is mounted on

the block 68 by a screw 72 and carries a contact 74 normally engaged with a contact 76 on the spring 64.

Resetting means is provided in the form of a coil of wire or solenoid 78 having a plunger 80 therein terminating in an armature 82 at its left end in Figure 3. When the coil is energized, this armature will be attracted toward the solenoid 78 so that the right hand end of the plunger 80 will engage the bimetal element A for effecting a resetting operation.

Referring to Figure 1, a burner control is shown in which a motor switch MS controls the flow of current to the burner motor BM and the ignition mechanism Ign. Current is also supplied to the primary P of a transformer T having a secondary S.

A room thermostat circuit is provided consisting of a room thermostat RT, a relay coil RC, the contacts 74 and 76 of our primary control and the heater 44 thereof, all in series with each other and supplied with current from the secondary S. A second and selective circuit is provided through the solenoid coil 78 and a contact 84 of a reset switch 86. Normally the reset switch is engaged with a contact 88 in the room thermostat circuit and when engaged with the contact 84 it is disengaged from the contact 88. The wires leading into the primary control indicated generally by the dotted outline PC in Figure 1 and designated as 90, 92 and 94 and are also shown in Figure 1a.

PRACTICAL OPERATION

Normal burner operation

In the operation of our invention, when the parts are in the cold position of Figures 3, 7 and 8, the contacts 74 and 76 are in engagement due to the resiliency in the spring arms 64 and 70. This results in the room thermostat circuit being closed across the wires 90 and 94 so that when the room thermostat itself closes, the relay coil RC will be energized in series with the heater 44 for initiating a burner operation. Closure of the motor switch MS of the relay starts the burner.

Energization of the heater 44 causes the bimetal portion 38 to become warped or curved as in Figure 9, the cold position being shown in Figures 3, 7 and 8. At the same time heat from the flame of the burner passing through the opening 29 effects similar warpage of the bimetal element section 42 as shown in Figure 9. Since both bimetal sections 38 and 42 are warped, the unanchored section 42 will assume approximately the same curvature as the anchored section 38 as shown in this figure, thus permitting the contacts 74 and 76 to remain in engagement.

The combustion chamber temperature will now rise and will cause some rise in temperature ambient to the primary control. This general rise in ambient temperature will cause the bimetal element A to warp as to a position slightly further than Figure 9.

There will also be further warpage due to direct heat from the combustion chamber affecting the bimetal element portion 42 and heat from the resistance wire 44 heating the bimetal element portion 38. Such warpage is substantially equal in both sections 38 and 42 so that the armature end of the bimetal element remains substantially in its original position thereby permitting the combustion contact 74 and 76 to remain closed.

Failure of combustion to be established

Referring to Figure 10, if combustion does not occur in the normal manner then bimetal element

section 33 will be heated by the heater 44 thus bending as shown but since there is no flame from the burner there is no heat passing through the opening 29 in the housing 28 to impinge the bimetal element section 42. The section 42 accordingly will remain straight and we have resultant separation of the contact 76 from the contact 74 due to the armature 52 travelling the length of the slot 69 and forcing the strip of insulation 61 toward the left in Figure 7. This breaks the circuit through the relay coil RC so that the motor switch MS drops open and thereby shuts down the burner.

The last portion of the movement of the armature 52 to effect contact separation is had in snap manner due to the armature 52 being quickly drawn by the magnet 54 to the position of Figure 10, with the screw 58 stopped against the screw 56. The armature will remain in this position, even though the bimetal cools down to its initial temperature and such cooling will cause the bimetal element to assume a shape somewhat similar to that shown in Figure 11. As both arms 38 and 42 tend to straighten up and the magnet is attracting the armature, the free end of the bimetal element is thus held offset from the anchored end and retains the switch open.

Combustion failure after establishment

In the event that combustion is successfully established and then fails, the section 42 of the bimetal element A will straighten out from its curved position shown in Figure 9 and assume the position shown in Figure 10 which also causes the contacts in the primary control to open. The section 38 will remain curved on account of the heat it is receiving from the heater 44 until such time as the contacts open and then of course it will cool down with the bimetal element finally assuming the position shown in Figure 11.

Resetting the primary control for operation after a shutdown

After a shutdown from any cause that resulted in combustion failure, the bimetal element A in the position of Figure 11 may be reset from a remote point by a switch located at that point and effecting energization of the solenoid 78. The switch 86 is provided for this purpose and it will be obvious that by depressing the push button 87 thereon current from the secondary S of the transformer T can be used to energize the solenoid.

Energization of the solenoid however is operable to attract the armature 82 thus causing the plunger 80 to move toward the right in Figures 3 and 11 as indicated by the arrow in the latter figure and engage the bimetal element A at a point substantially midway of its section 42.

This results in an impact blow being delivered to the bimetal element that moves the armature 52 away from the magnet 54 thus placing it in a weakened magnet field so that the magnet no longer attracts the armature 52 with sufficient force to overcome the tendency of the bimetal element to straighten up to its original position. The result is that the bimetal element does so straighten up to the position of Figure 7 and is then in condition for another safety shutdown operation.

By mounting both of the bimetal element sections 38 and 42 within the housing 26-28 they are in substantially the same ambient temperature which may fluctuate anywhere between a cold start temperature and a temperature at-

tained by long running of the burner, for instance 400° F. Therefore the bimetal element is self-compensating for any temperature that it encounters as ambient temperature affects both sections 38 and 42 equally and merely causes more or less warping without changing the position of the actuating end 42 relative to the anchored end 38. The section 42 however is additionally responsive to combustion temperature whereas the section 38 is additionally responsive to the heater 44 whereby the two sections are brought out of step as indicated by the position of Figure 10 whenever there is combustion failure from any cause.

The single set of contacts 74 and 76 connected as they are in the room thermostat circuit takes the place of both the safety switch contacts and the combustion switch contacts in the usual type of stack switch having a temperature responsive element in the stack, and a safety switch including a heater therefor.

In our arrangement the one bimetal element A responds to both an electrical heater and to temperature in the furnace in such manner that a single set of contacts serve as a safety control in response to combustion and also to burning out or other failure of the heater 44 which of course would open the relay circuit and the control could not be re-operated until the heater had been replaced.

The reset coil 78 has been found to be a very satisfactory means to reset the primary control with the manual control for effecting reset located at any desirable remote point and electrically connected thereto. At the time of resetting, if the room thermostat RT is calling for heat the burner does not operate because of the circuit of the room thermostat being broken across the switch 87 at its contact 88. Thus we effect a "trip free" type of resetting operation for the primary control.

Some changes may be made in the construction and arrangement of the parts of our device without departing from the real spirit and purpose of our invention, and it is our intention to cover by our claims any modified forms of structure or use of mechanical equivalents which may be reasonably included within their scope.

We claim as our invention:

1. A primary control for burners comprising a base member adapted to be mounted on an oil pipe in an oil burner nozzle, a torus-shaped bimetal element adapted to surround the oil pipe and mounted on said base, said bimetal element having one end anchored and the other end free and constituting an actuating element, a combustion switch having normally engaged switch contacts which are controlled by said actuating element, an electric heater for said bimetal element to effect warpage of substantially one-half thereof to thereby tend to disengage said contacts, the other half adapted to be responsive to direct heat from the flame issuing from the oil burner nozzle to thereby tend to retain said contacts in engagement when said bimetal element responds to heat from both said electric heater and direct heat from the burner flame, a housing around both halves of said bimetal element and adapted to surround the oil pipe, said housing being subject to ambient temperature within the burner nozzle and having an opening through which heat from the flame may pass to the bimetal element, snap acting means to retain said contacts open when once they are opened by flame failure, and resetting means for said snap acting means elec-

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trically operated and manually controlled from a remote point.

2. A primary control for burners comprising a torus-shaped bimetal element adapted to surround the oil pipe in an oil burner nozzle, said bimetal element having one end anchored and the other end free and constituting an actuating element, a burner control circuit, a combustion switch having normally engaged switch contacts in said control circuit which are adapted to be opened by said actuating element, an electric heater for said bimetal element to effect warpage of substantially one-half thereof to thereby tend to disengage said contacts, a housing for said bimetal element and said electric heater, said housing having a window, said other half of said bimetal element adapted to be responsive through said window to direct heat from the flame issuing from the oil burner nozzle to thereby tend to disengage said contacts, magnet and armature means to retain said contacts separated after they are separated due to combustion failure, reset mechanism comprising electro-magnetic means including a plunger to engage said bimetal

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element, overcome the pull of the magnet on the armature and move the armature back to initial position where it is no longer attracted by the magnet, and a two-way switch for said electro-magnetic means, said two-way switch when in normal position being connected in the control circuit and when in reset position being connected in the electro-magnetic means circuit to de-energize the control circuit and energize the electro-magnetic means circuit when the reset mechanism is energized.

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