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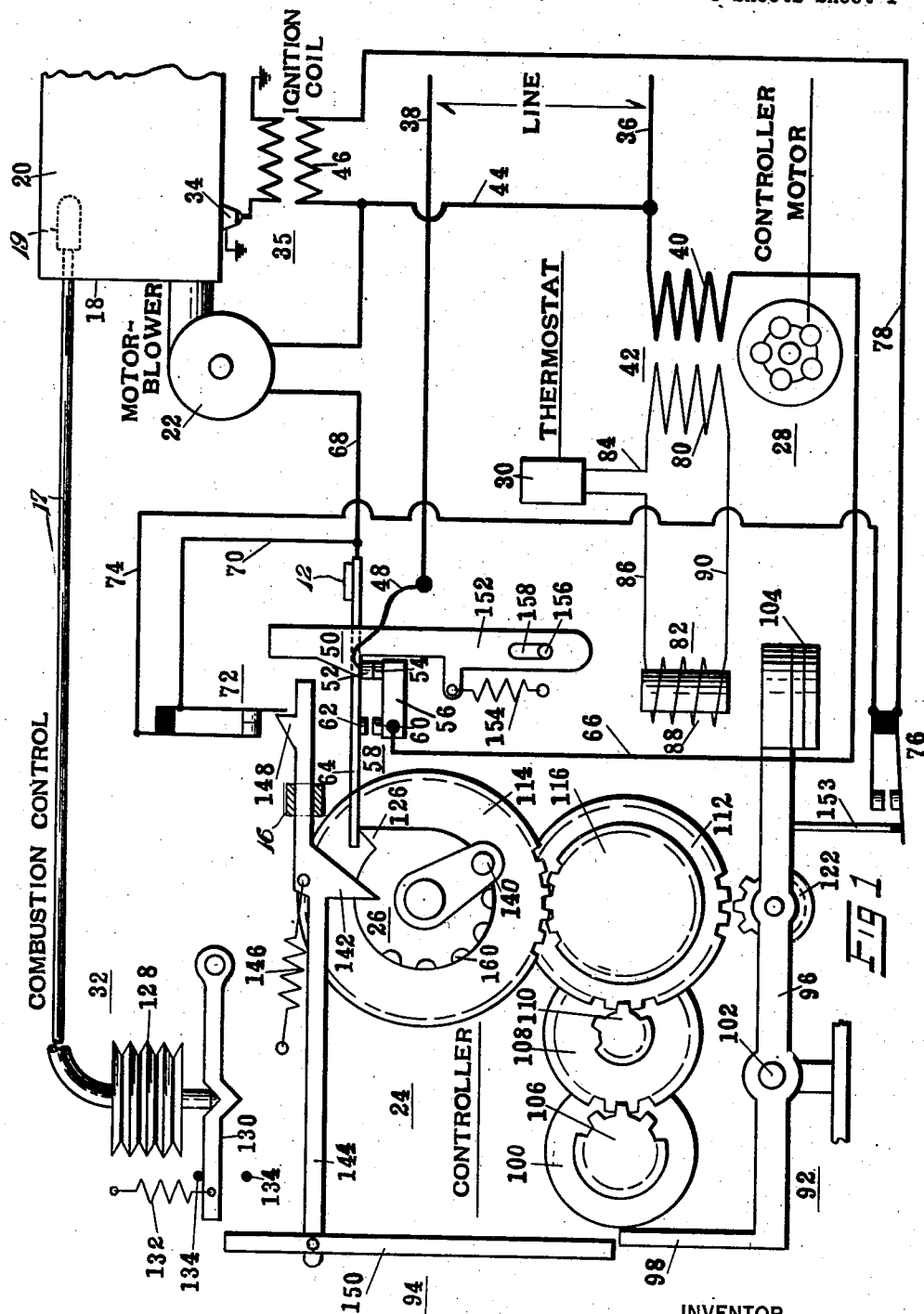
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2,185,752

OIL BURNER CONTROL APPARATUS

Filed Nov. 18, 1936

3 Sheets-Sheet 1



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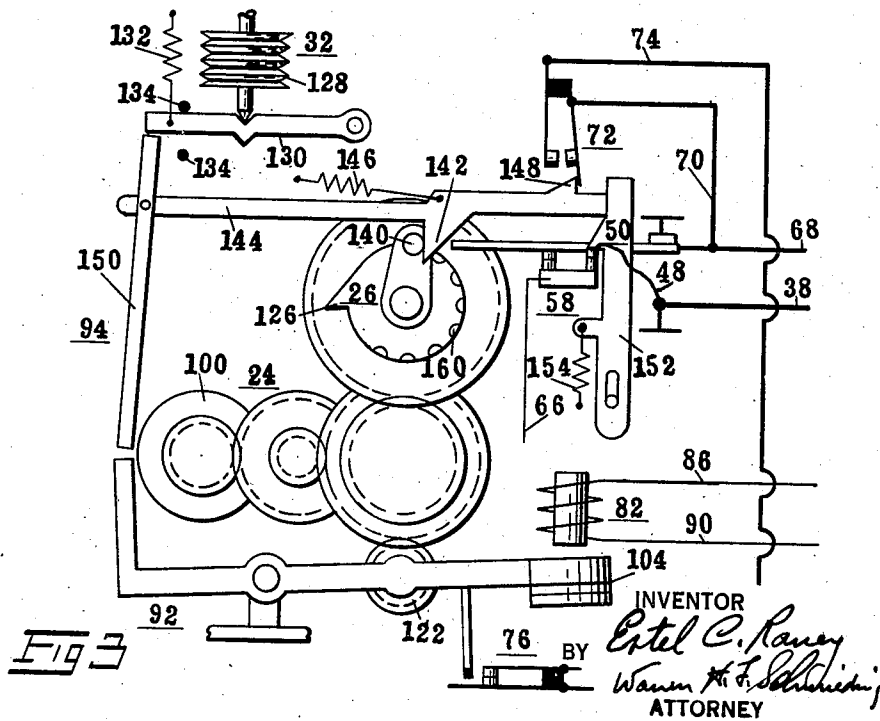
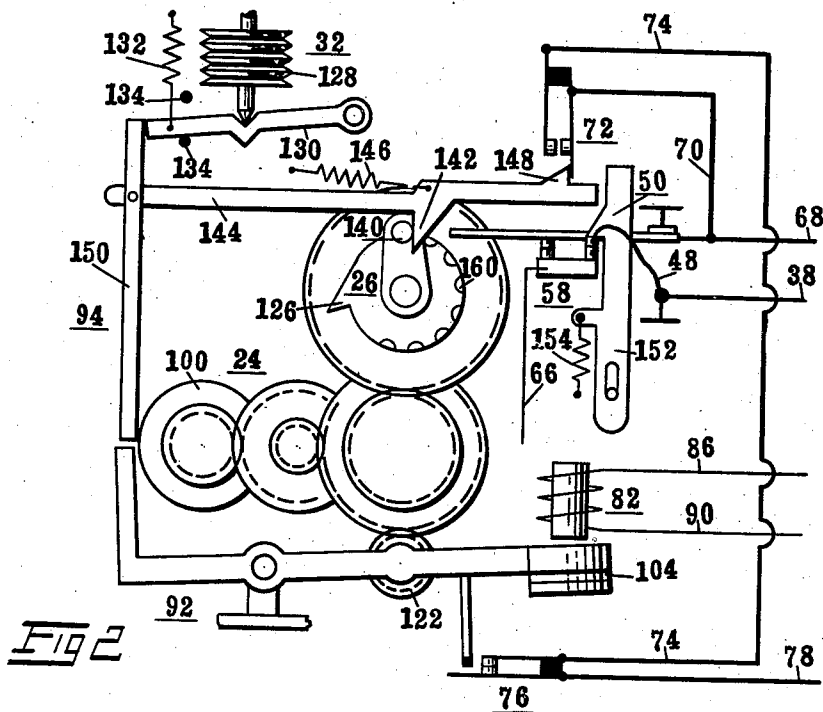
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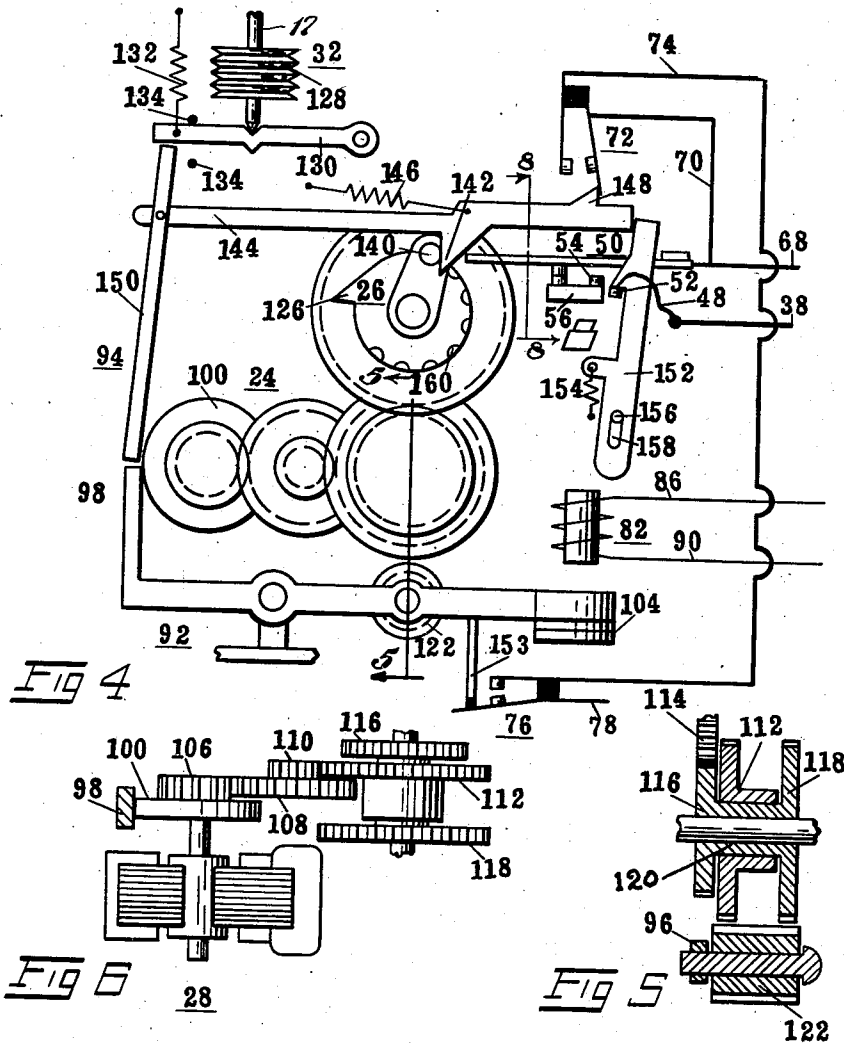


Fig 4

Fig 6

Fig 5

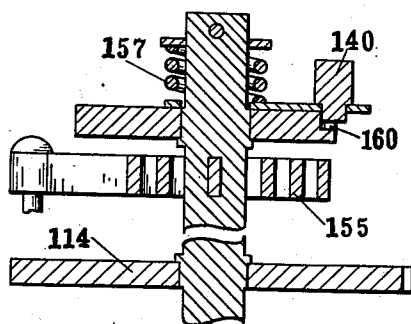


Fig 7

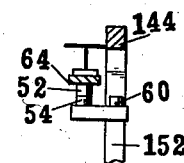


Fig 8

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2,185,752

OIL BURNER CONTROL APPARATUS

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Application November 18, 1936, Serial No. 111,480

3 Claims. (Cl. 158—28)

My invention relates to control systems and more particularly to electrical control circuits and mechanism for controlling fuel burning apparatus.

One of the objects of the present invention is to provide a control system for fuel burning apparatus in which various controls are rendered effective and ineffective in a preselected sequence, when the fuel burner functions in the normal manner, and which control system prevents damage to the system in the event of any abnormal condition. In carrying out this object is a further object of the present invention to provide a controller including a timing device and driving mechanism therefor, in which the driving mechanism is controlled by temperatures of the room to be heated and by combustion temperatures; to provide for connecting the driving mechanism with the timing device for starting the system; to prevent the driving mechanism from operating the timing device during the demand for heat from the fuel burning apparatus; to provide for disconnecting the driving mechanism from the timing device after the demand for heat has been satisfied so that the timer is in condition for restarting the fuel burning apparatus upon reoccurrence of a demand for heat; to provide for the simultaneous flow of current for the burner motor and for the electric ignition and for discontinuing the ignition after a predetermined time while continuing the supply of current for the burner motor; to prevent reoccurrence of ignition except during the starting operation; and for rendering the system inoperative in the event of failure of combustion.

Another object is to provide a timing device for such a system in which the time interval for operation of the same can be adjusted.

Other and further objects and advantages will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a schematic diagram of a control system as applied to an oil burning system; the controller for the system is shown during a period of non-operation:

Fig. 2 is a schematic diagram of the system showing the controller during a normal operating period:

Fig. 3 is a diagram similar to Fig. 2 but showing the controller in the position before deenergization due to failure of combustion:

Fig. 4 is a view similar to Fig. 2 after the system has been deenergized due to a failure of combustion:

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 4:

Fig. 6 is a side elevational view of the controller motor and its gearing:

Fig. 7 is a sectional view of the timing device showing the return spring and timing adjustment and,

Fig. 8 is a sectional view taken on line 8—8 of Fig. 4.

An embodiment of my invention is shown in Fig. 1, wherein the control system is utilized to control an oil burning system. A furnace 18 is provided with a combustion chamber 20 and an associated electrically driven fuel feeding device 22, which may be a motor-blower. The operation of the system is controlled by a controller 24, which includes a timing device 26 and a driving motor 28 therefor. The timing device 26 is disposed to operate a plurality of control switches, in a preselected sequence, for initiating and stopping the various functions of the system. A room thermostat 30 controls the normal operation of the system by causing the driving motor 28 to operate the timing device 26 when there is a demand for heat, and by causing the system to cease operation when the demand for heat is satisfied. A stack, or combustion control, generally indicated at 32, is provided to cause the system to stop operation, when an emergency condition occurs; such as a fuel failure, or a failure to establish combustion. A spark plug 34, or other type of igniting means, is positioned adjacent the discharge of motor-blower 22 to ignite the fuel therefrom.

The system includes two circuits, namely a control circuit for the fuel feeding device 22, and for an ignition coil 35 and a secondary control circuit that includes the room thermostat 30. The first mentioned circuit may be traced as follows: current is supplied by power lines 36 and 38; line 36 is connected directly to a primary winding 40 of a transformer 42, line 36 is also connected by wire 44 to a primary 46 of the ignition coil 35 and to the motor-blower 22. The other line 38, is connected by a flexible connection 48 to an emergency switch 50, which includes contacts 52 and 54. A block 56, of conductive material, electrically connects the switch 50 to a switch 58, which includes contacts 60, 62 and a spring contact member 64 which carries contact 62. The member 64 is supported at one end by a bracket 12. It will be noted that the current passing through switch 50 divides; part traversing the switch 58 and the other part passing through wire 66 to the primary 40 of transformer 42. Thus the transformer primary 40 is constantly energized when the emergency switch 50 is closed, which is the normal position of the switch. The division of current that passes through switch 58, traverses the member 64 and divides, part passing by wire 68 to the motor-blower 22 and the other part passing through

wire 70, switch 72, wire 74, switch 76, and wire 78 to the primary 46 of the ignition coil. Thus when switches 50 and 58 are closed the motor-blower is energized. The energization of the ignition coil 36 however, is dependent on the concurrent closure of the switches 50, 58, 72 and 76. From the foregoing it is apparent that the switch 50 controls the entire system.

The secondary control circuit includes a secondary winding 80 of the transformer 42, the room thermostat 30 and an electro-magnet 82. The circuit is as follows; secondary winding 80, wire 84, thermostat 30, wire 86, coil 88 of electro-magnet 82, wire 90 to the secondary 80. Thus the secondary circuit is a closed circuit, which is controlled entirely by the opening and closing of the thermostat 30.

The primary 40 of the transformer 42 is wound directly on the field core of the controller motor 28, which motor is preferably of the shaded pole type. The primary 40 is utilized as the field winding for the motor 28. The secondary winding 80 of the transformer 42 is also wound on the core of the motor 28 which core is utilized as the core for the transformer. Since the primary winding 40 which is also the field for the motor 28, is constantly energized, it is apparent that the motor 28 is always capable of rotation.

In order to selectively control the operation of the motor 28, means are provided for preventing the operation of the motor. This means includes two friction brakes, 92 and 94 respectively. The brake 92 includes a substantially L shaped lever 96, the upturned end, or leg, of which is designated at 98. The leg 98 is disposed to frictionally engage the periphery of a disc 100, which disc is carried by the shaft of the motor 28. The lever 96 is pivoted at 102 and weighted by a weight 104 at the end opposite the upturned leg 98. Thus the lever 96 pivots around its bearing 102, due to the weight 104 and causes the leg 98 to bear, or drag on the periphery of the disc 100. In this position, therefore, the brake 92 provides sufficient retarding force to stop the rotation of the motor 28. The weight 104 is disposed sufficiently close to the magnet 82, so that when the magnet 82 is energized, there is sufficient magnetic force to attract the weighted end of the lever 96 and remove the brake from the disc 100. Thus when the secondary control circuit is complete, due to the closure of the thermostat 30, the motor 28 is operative.

The motor 28 is engaged to the timing device 26 during operating periods of the system by reducing gearing. The motor 28 is directly engaged to gears 106, 108, 110 and 112, while the timing device 26 is directly engaged to gears 114, 116 and 118. The gear 116 is substantially unitary with the gear 118. The gears 116 and 118 are fixedly mounted and spaced on a hub 120, and the gear 112 is journaled on the hub 120 between the gears 116 and 118. The gears 112 and 118 are of substantially the same diameter and pitch. In order to operatively engage the motor 28 and timing device a relatively wide engaging gear 122 is provided which is adapted to be meshed with the gears 112 and 118 simultaneously. The gear 122 is carried by the lever 96, so that when the secondary control circuit is closed and the lever 96 is raised at its weighted end by the magnet 82, the gear 122 meshes with gears 112 and 118 to actively engage the motor and the timing device. It is apparent therefore that the gearing is only

engaged when the brake 92 is removed to allow rotation of the motor 28.

The timing device 26 is provided with a projection or spur 126 which engages the spring member 64 of switch 58 and separates the contacts 60 and 62, when the system is not operating. When the thermostat 30 calls for heat and completes the secondary control circuit, the brake 92 is removed from the controller motor 28 and the motor and timing device are engaged and the latter starts to rotate in a clockwise direction. As the timing device 26 revolves it displaces the spur 126 from engagement with member 64, which caused the switch 58 to close. Closure of the switch 58 simultaneously completes two circuits, first it energizes the fuel feeding device or motor-blower 22, and secondly it completes the circuit to the ignition coil 35. This last circuit it will be noted is broken by switch 76 when the lever 96 is in braking position but when the electro-magnet 82 is energized to attract the weighted end of lever 96, the switch 76 is closed. Thus fuel is fed to the combustion chamber and the ignition means therefore are rendered operative.

The combustion responsive control 32 is positioned so that its thermal element is affected by temperature changes in the chamber 20, caused by the establishment of combustion. One form of thermal responsive combustion control is shown, which utilizes a bellows 128 connected by a capillary tube 17 with a bulb 19 filled with a suitable volatile fluid and located in the combustion chamber 20. An increase in temperature within the chamber 20, causes the bellows 128 to elongate, which change in length is transmitted to a lever 130. The lever 130 is pivoted at one end thereof and connected to a spring 132 at the other end. The spring causes the lever 130 to be in constant engagement with the bellows 128. Stops 134 are provided to limit the movement of the lever in either direction. Thus the lever is against the upper stop 134 when the system is inoperative and against the lower stop 134 when the system is operative, this last position being caused by displacement due to elongation of the bellows 128 to force the lever 130 downwardly as is shown in Fig. 2.

During the initial operating, or heating up period of the system, the timing device 26 is rotated slowly by the motor 28 until a stop 140, on the timing device, engages a projection 142 disposed on a member 144, slidably mounted on guides 16. The member 144 is biased by a spring 146 to resist lateral movement of the lever as imparted by the stop 140. However the member 144 is displaced to the right, as viewed in Fig. 1, by the movement of stop 140 until a projection 148 on the member 144 engages the switch 72, to open the switch 72 and break the ignition circuit. In this manner the ignition coil 35 is only energized for a predetermined time period after the closure of switch 58.

The outer end of the member 144 carries a pivotally mounted lever 150. The lower end of lever 150 is disposed to ride on the periphery of the disc 100. As the slidable member 144 is moved to a position beyond the position required to open switch 72, the upper end of lever 150 engages the end of downwardly displaced lever 130 of the stack control. This fixedly positions the upper end of the lever 150 and further movement of lever 144 causes the lower end of member 150 to drag on the disc 100 sufficiently to cause the motor 28 to stop. Thus the brake, generally

indicated at 94, is applied when the system is functioning properly as illustrated in Fig. 2. If the fuel does not ignite, the stack control 32 remains inoperative. In this case the lever 130 of the stack control is not interposed to stop the inward movement of member 144 and apply the brake 94, and the timing device 26 will continue to rotate until the inner end of the displaced member 144 engages the emergency switch 50 to cause separation of contacts 52 and 54. As the contacts separate the contact lever 152 of switch 50 is drawn downwardly by a spring 154. A pin 156, in an elongated slot 158, limits the downward movement of the lever 152. When contacts 52 and 54 are separated the entire system is de-energized and operation cannot be resumed until lever 152 has been manually reset to re-engage contacts 52 and 54. The described position is shown in Fig. 4.

This same action occurs if the flame should become extinguished or the fuel supply should fail, during a normal operating period. The only difference being the lever 130 would necessarily have to be drawn out of engagement with the upper end of the lever 150. This movement of lever 130 would occur due to cooling and retraction of the bellows of the combustion control 32. At the instant the levers 130 and 150 are disengaged the brake 94 is released and the motor and timing device can resume operation until the switch 50 has been operated as previously described. Thus if any emergency arises, either during a starting operation, or during a normal operating cycle, the system is completely de-energized.

Whenever the system has been deenergized either by the emergency operation of switch 50, or by the normal action of the thermostat 30, the lever 96 drops to the position shown in Fig.

1. This disconnects the gearing between the motor 28 and the timing device 26. As the lever 96 drops, a pin 153 mounted on the lever separates the contacts of switch 76 to break the ignition circuit. Simultaneously with the disengagement of the motor and timing device, the timing device 26 is rotated counterclockwise to its starting position. This is accomplished by a spiral spring 155 fixedly attached to the timing device at one end thereof and anchored at its other end. Thus the spring 155 is wound up or increased in tension, as the timing device rotates in a clockwise direction. When the timing device is disengaged this spring 155 unwinds and returns the timing device to its starting position with spur 126 engaging, and separating the contacts of switch 58.

In this manner the system is in position for a subsequent operation. The switch 76 is provided to prevent reoccurrence of ignition as the timing device is being returned to its starting position.

It is apparent that as the timing device rotates in a counterclockwise direction, the switch 72 will again close and if switch 76 were not provided the ignition circuit would again be energized. This condition would be dangerous in the event that the flame had become extinguished and the thermostat 30 had opened the circuit to deenergize the system at some time after the flame extinguishment had occurred. In this case the combustion chamber 20 would be charged with ignitable fuel and the energization of the ignition circuit would cause an explosion. The provision of switch 76 assures but one occurrence of ignition during each cycle of operation. In

other words the timing device 26 must come back to its starting position before the ignition coil can be energized.

The position of the stop 140 on the timing device 26 determines the time period of operation of the ignition circuit and of the timing device. These periods may be varied by raising the stop 140 against a compression spring 157 and resetting the stop in any one of the plurality of holes 160 which are provided around the circumference of the timing device 26. In this manner the angle of rotation of the timing device may be changed to vary the time period of operation.

From the foregoing it will be noted that I have provided a complete and automatic fuel control system that not only initiates combustion, but maintains the same under control to provide desired temperatures. The system includes a safety control to check the establishment and maintenance of combustion; it also includes a time controlled ignition device for igniting the fuel, which ignition cannot re-occur except during the starting operation of the system. Thus the system is controlled for normal operation and also is controlled to assure safety during abnormal or emergency operation.

While the form of embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adapted, all coming within the scope of the claims which follow.

I claim:

1. In a control system for a fuel burning apparatus, a circuit for controlling the operation of the apparatus; a switch in the circuit; a timing device, operable after a predetermined period of energization of the circuit, for opening the switch, said timing device including an electric motor constantly energized when the circuit is energized and constantly tending to actuate the device; means responsive to the establishment of combustion; a friction brake for stalling the timing device; and mechanism actuated by the timing device, after a predetermined operation of the device and rendered effective by the means, for actuating the brake to stall the timing device.

2. In a control system for a fuel burning apparatus, a circuit for controlling the operation of the apparatus; a device including an electric motor energized constantly during a demand on the fuel burning apparatus; a switch in said circuit opened by the device after a predetermined operation of the device; means responsive to the establishment of combustion; a friction brake for stalling the motor; and mechanism actuated by the device, after a predetermined operation of the device and rendered effective by the means, for actuating the brake to stall the motor.

3. In a control system for a fuel burning apparatus, a circuit for controlling the operation of the apparatus; switching means in the circuit; a timing device for actuating the switching means, said timing device including a continuously energized electric motor and mechanism for actuating the switching means, said mechanism being adapted to be driven by the motor; means for connecting and disconnecting the motor from the mechanism in response to temperature changes; and a brake for stalling the motor, said brake being actuated by the last mentioned means to stall the motor when the motor is disconnected from the mechanism.

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