Dec. 11, 1951 C. M. MAYER ET AL 2,577,787

GAS BURNER CONTROL MECHANISM

Filed April 3, 1950 3 Sheets-Sheet 1

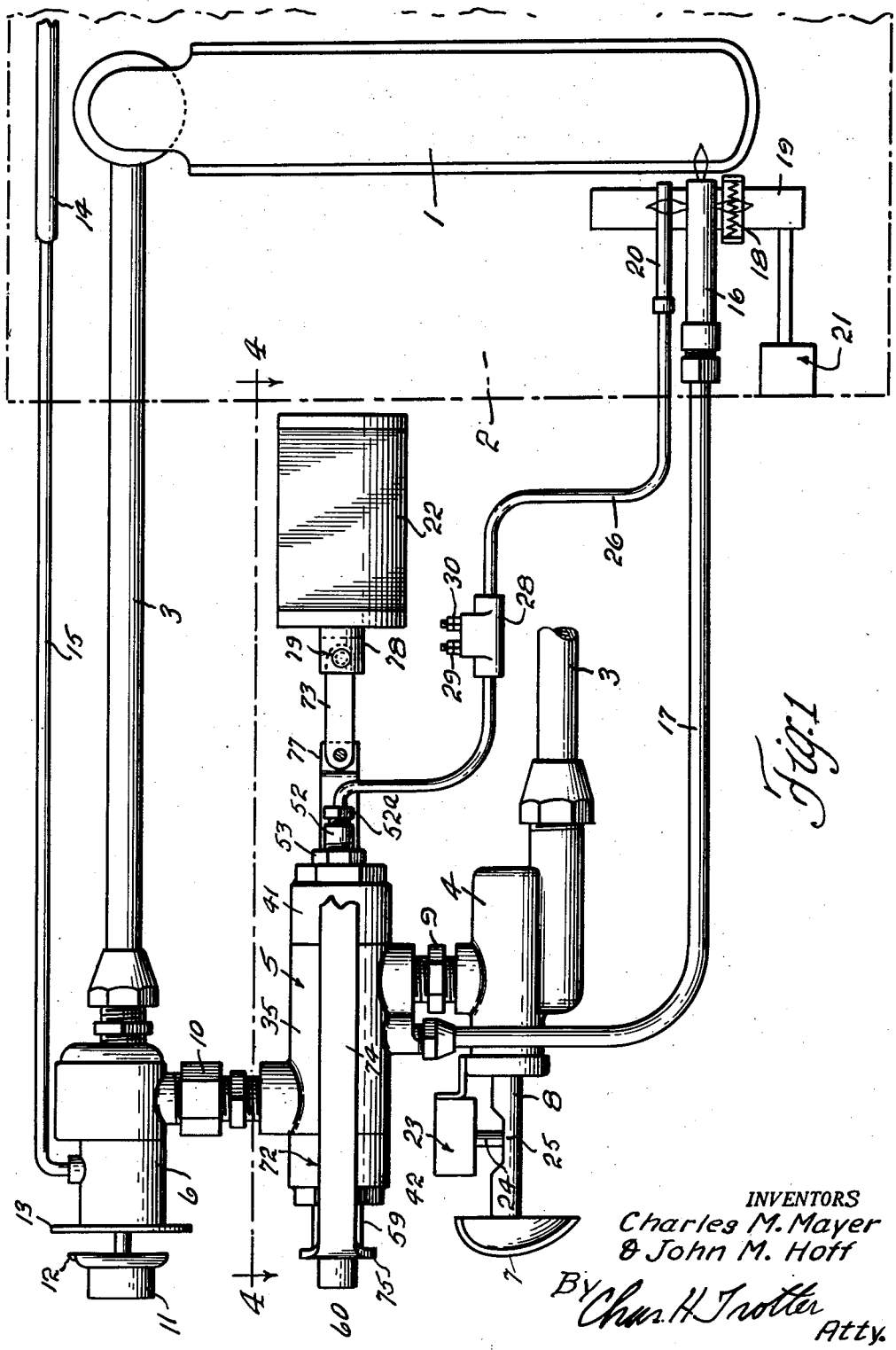


Fig. 1

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Fig. 2

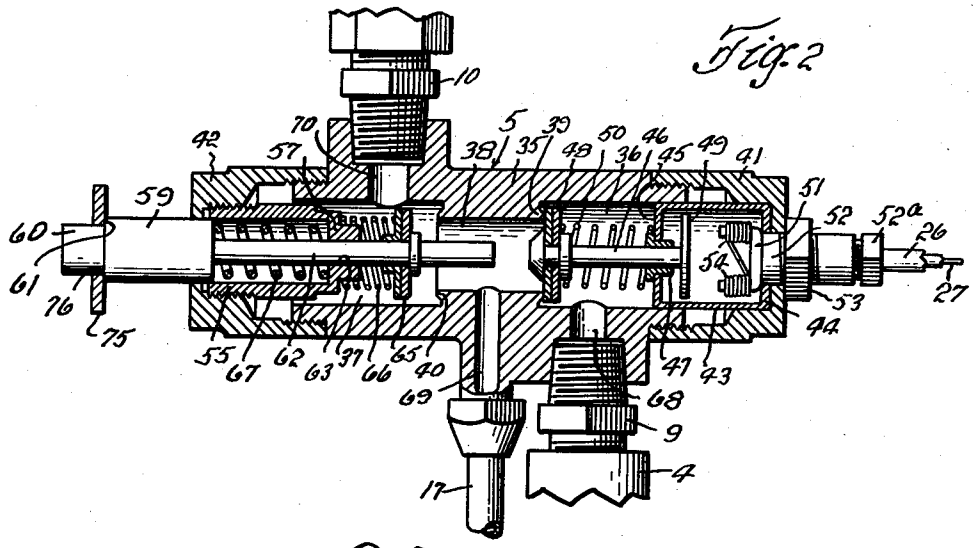
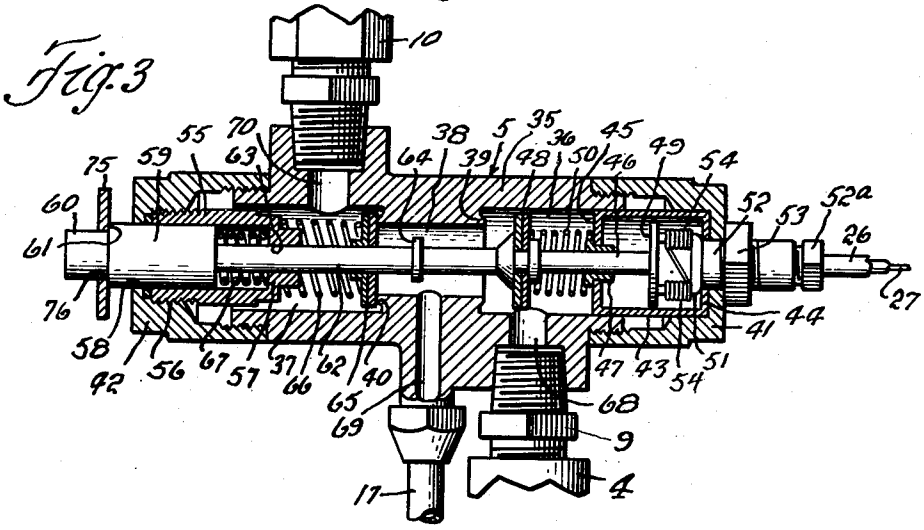


Fig. 3



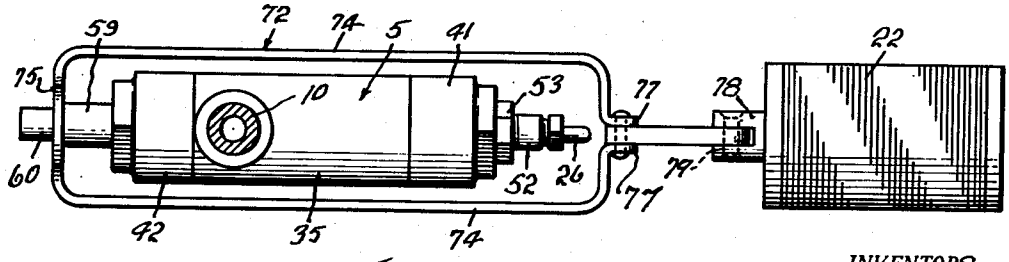


Fig. 4

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GAS BURNER CONTROL MECHANISM

Filed April 3, 1950 3 Sheets-Sheet 3

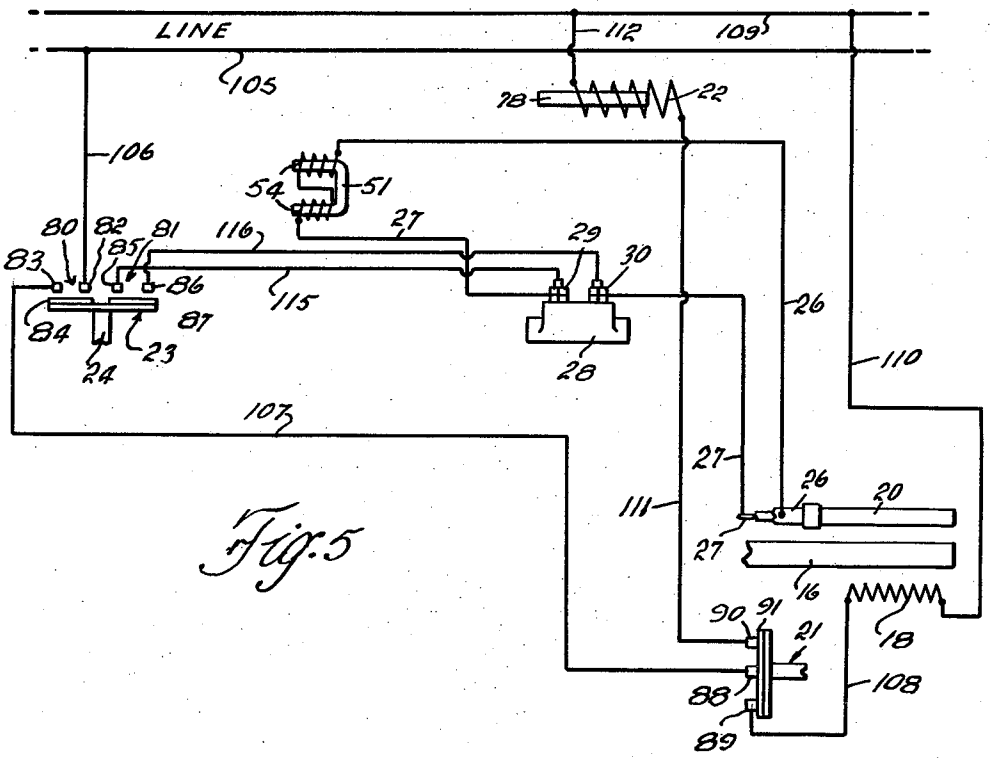


Fig. 5

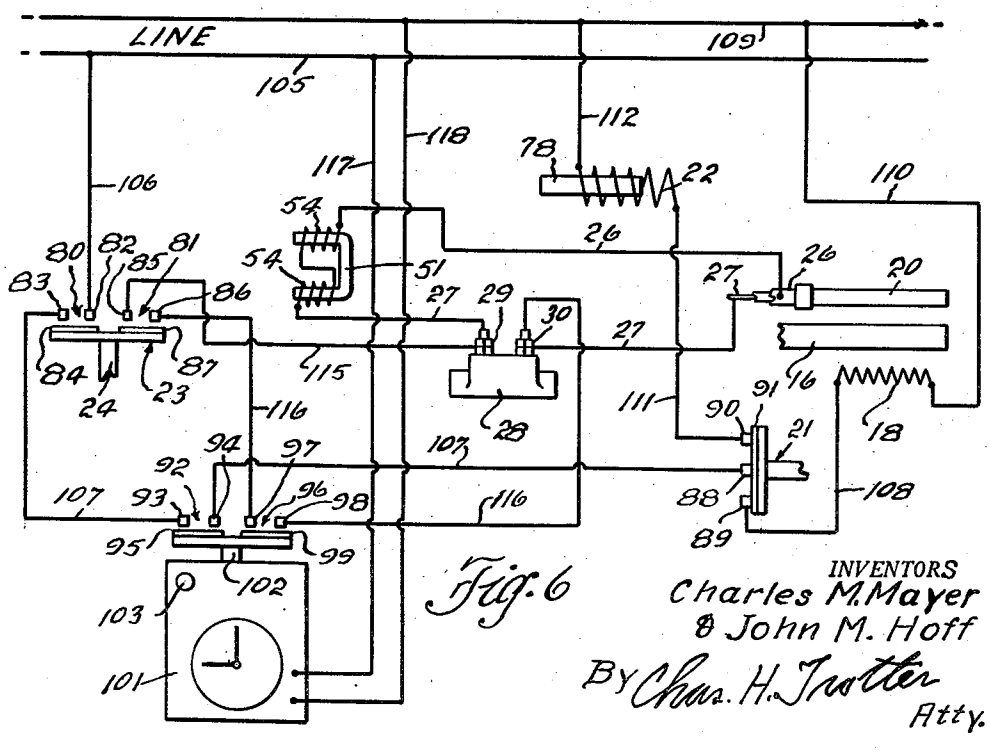


Fig. 6

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UNITED STATES PATENT OFFICE

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GAS BURNER CONTROL MECHANISM

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Application April 3, 1950, Serial No. 153,664

11 Claims. (Cl. 161—9)

1

This invention relates to an automatic electric ignition and control mechanism for cooking range burners using gaseous fuel. It is especially designed and adapted for automatically igniting and controlling the operation of oven burners in cooking ranges; but it may be used equally well to control the operation of other gaseous fue' burners. It may be used in conjunction with a time control mechanism or independently thereof as desired.

The mechanism is designed for use with a main gaseous fuel burner which is adapted to be ignited by a constantly burning gaseous fuel pilot burner. As long as the pilot burner is ignited it is immaterial whether or not the main burner burns constantly. It may be extinguished for some reason but it will be promptly re-ignited by the pilot burner if fuel is supplied thereto. But if the pilot burner is extinguished for any reason while the main control valve is still open to supply gas to the main burner a very dangerous situation sometimes arises. Let us assume that both the pilot burner and the main burner are extinguished during operation for some reason. Gas can then flow to the main burner but since the pilot burner is extinguished the main burner will not be ignited and unburned gas will accumulate in the oven which may violently explode when an attempt is made to ignite either the main or pilot burner. This is likewise true if gas to the main burner is cut off by the main control valve when the oven is not in use and the constantly burning pilot burner becomes extinguished for any reason. It has been found by experience that both the pilot burner and the main burner are frequently extinguished during use while the main control valve is open to supply gas to the main burner. It has also been found that a constantly burning pilot burner is frequently extinguished for some reason while the oven is not in use and the supply of gas to the main burner is cut off. This is sometimes due to a momentary failure of the gas supply or the slamming of the oven door or to various other reasons.

In order to prevent any accumulation of unburned gas and thus eliminate any danger of an explosion therefrom in the event the pilot burner is extinguished for any reason while the control valve is still set to supply gas to the main burner, we provide in our improved apparatus safety control mechanism by which the supply of gas to both the main burner and the pilot burner is completely cut off, independently of the main control valve, in the event the pilot burner is extinguished for any reason while the main gas control valve is open.

Our improved apparatus includes a main gaseous fuel burner by which the oven in a cooking range is heated. The main burner is adapted to be ignited by a gaseous fuel pilot burner which burns only during the time the oven is in operation. At other times the supply of gas to both the main burner and the pilot burner is cut off by a main control valve which is interposed in a conduit between the gas supply manifold and the burners. When the main control valve is open gas will flow from the manifold through the main control valve and into a safety control valve mechanism. From the safety control valve mechanism gas will flow through a small branch conduit directly to the pilot burner; and through the main conduit and a standard thermostatically operated oven temperature control valve to the main burner. A normally open master control switch which is operatively associated with the main control valve is arranged to be closed by the opening of the main control valve and to be opened by the closing of the main control valve. The closing of the master control switch, as the main control valve is opened to supply gas to the burners, energizes through a normally closed thermostatically operated switch an electric resistance ignition element and a solenoid which is operatively connected to the safety control valve mechanism. The energization of the solenoid causes it to operate the safety control valve mechanism to permit the flow of gas to the pilot burner while cutting off the supply of gas to the main burner. The pilot burner is ignited by the electric ignition element and projects a flame against a thermostatic element, which controls the operation of the normally closed switch, and against a thermo couple which is operatively connected to the safety control valve mechanism. After the thermostatic element becomes heated it opens the normally closed switch which de-energizes the electric ignition element and the solenoid. As soon as the solenoid is de-energized the safety control mechanism is automatically operated by spring means to supply gas to the main burner through the oven temperature control valve. The main burner is then ignited by the pilot burner. The thermocouple, as long as it is heated by the pilot burner, maintains the safety control valve mechanism in condition to supply gas to both the main burner and the pilot burner. The oven temperature control valve then regulates the supply of gas to the main burner so as to maintain the desired oven temperature. As long as the pilot burner is ignited the main burner will burn normally under the control of the oven temperature control valve until the main control valve is manually turned off. But if during operation the pilot burner is extinguished for any reason the thermocouple will immediately cool and allow the safety control valve mechanism to automatically cut off the supply of gas to both the main burner and the pilot burner. As an example of the manner of operation of the apparatus, let us assume that during operation the pilot burner is suddenly extinguished, for instance, by a momentary failure of the gas supply from the mani-

fold to the burners. The thermocouple immediately cools, allowing the safety control valve mechanism to cut off communication between the manifold and both the main burner and the pilot burner. The main control valve is still open and the master switch closed. Then after the thermostatic element has cooled, closing the normally closed switch, which is maintained open by the thermostatic element during normal operation of the oven, the electric ignition element and the solenoid are again energized. The energization of the solenoid will cause it to operate the safety control valve mechanism to establish communication between the manifold and the pilot burner only. Then when gas is again available the pilot burner will be ignited and reestablish normal operation of the oven as previously described. In the event of a power failure during normal operation of the oven, the main burner will continue to operate normally under the control of the oven temperature regulator valve until the burner is turned off by the main control valve, assuming of course that the pilot burner continues to burn. In the event of a power failure before gas is turned on by the main control valve, the pilot burner can be manually ignited as will be hereinafter explained. The supply of gas to both the main burner and the pilot burner will then be controlled by the pilot burner through the thermocouple and safety control valve mechanism as previously described.

In addition to the aforesaid possibilities of accumulating unburned gas in an oven, there is one other condition under which unburned gas could collect in an oven. Our improved control apparatus is also designed to take care of this contingency and prevent the accumulation of unburned gas in an oven should this condition ever occur. For example, assume that while the main burner is operating normally the main control valve is closed and then immediately opened again before the thermocouple and the thermostatic element have had time to cool. The closing of the main control valve extinguishes both the main burner and the pilot burner by cutting off the supply of gas thereto. Then when the main control valve is immediately reopened gas is again supplied to both the main burner and the pilot burner since the thermocouple has not had time to cool sufficiently to allow the safety control valve mechanism to operate to cut off the supply of gas to both burners. But under this condition the pilot burner will not be ignited because the still hot thermostatic element is maintaining the normally closed switch open and preventing energization of the electric ignition element and of the soleniod. Thus unburned gas will escape from both the main burner and the pilot burner into the oven until the thermostatic element cools and closes the normally closed switch. As soon as the thermostatic element cools sufficiently it will energize the ignition element which will ignite the pilot burner and it in turn will ignite the main burner. But in the meantime enough gas may have escaped into the oven from the main burner and the pilot burner to cause a bad explosion when the pilot burner is again ignited. In order to eliminate the escape of any unburned gas into the oven whenever this condition occurs, I provide an interrupter switch in the circuit between the thermocouple and the safety control valve mechanism. This switch is located in the same casing as the master control switch and is opened and closed by the closing and opening of the main control valve simultaneously with the opening and closing of the master control switch. Then

when the main control valve is closed to cut off the supply of gas to the burner the interrupter switch is simultaneously opened, breaking the circuit between the thermocouple and the safety control mechanism which permits the safety control switch mechanism to cut off all communication to both the pilot burner and the main burner. Then when the main control valve is immediately opened after having been momentarily closed nothing will happen until the thermostatic element cools and closes the normally closed switch which occurs between six and ten seconds. After that the apparatus functions in its normal manner as has been explained.

When it is desired to use the apparatus in conjunction with any standard time control mechanism we provide a supplemental master switch and a supplemental interrupter switch which are simultaneously opened and closed at predetermined times by the time control mechanism. The supplemental master switch is inserted in the main circuit in series with the primary master switch, and the supplemental interrupter switch is inserted in the thermocouple circuit in series with the primary interrupter switch. In use the time control mechanism is set to initiate operation of the oven burner at a predetermined time and to terminate operation thereof at a predetermined later time, after the main control valve has been turned on which closes the primary master switch and the primary interrupter switch. Then when the supplemental switches which are in series with the primary switches are closed by the time control mechanism the apparatus will function in the same manner as previously described. When a range is equipped with a time control mechanism, means to lock the supplemental switches closed is also provided in order that the apparatus may be used independently of the time control mechanism if desired.

The principal object of the invention is to provide an improved electrical ignition and automatic control system for cooking range oven burners using gaseous fuel.

Another object of the invention is to provide in an electrical ignition and control system of the character described improved means for completely shutting off the supply of gas to both the main burner and the pilot burner in the event the pilot burner becomes extinguished for any reason before the supply of gas to both the main burner and the pilot burner is cut off by the main control valve.

Another object of the invention is to provide in an apparatus of the character described means to prevent the escape of any unburned gas in the event the main control valve is turned off after a period of operation and is then immediately turned back on before the heat responsive elements in the system have had an opportunity to cool.

Still another object of the invention is to provide an improved electrical ignition and control system of the character described which may be used in conjunction with a time control mechanism or independently thereof as desired.

Other and more limited objects of the invention will be apparent from the following specification and the accompanying drawing forming a part thereof, wherein:

Fig. 1 is a diagrammatic view illustrating our improved electrical ignition and safety control mechanism as applied to a cooking range oven burner using gaseous fuel;

Fig. 2 is an enlarged central longitudinal vertical section through the safety control valve mechanism showing the various parts in the position they assume when the oven burner is turned off;

Fig. 3 is a view similar to Fig. 2 showing the various parts in the positions they are automatically moved to when the main control valve is first turned on to initiate the operation of the main oven burner;

Fig. 4 is a horizontal section taken on the line 4—4 of Fig. 1;

Fig. 5 is a wiring diagram of the apparatus as used independently of a time control mechanism; and

Fig. 6 is a wiring diagram of the apparatus as used in conjunction with a time control mechanism.

Referring now to the drawings by reference characters, the numeral 1 indicates a gaseous fuel burner which is mounted in or in heating relation to a cooking range oven 2. Gaseous fuel is supplied to the burner 1 from a manifold (not shown) through a conduit 3. Interposed in the conduit 3 are a main control valve 4, a safety control valve mechanism generally indicated by the numeral 5, and an oven temperature control valve 6. The main control valve 4 is a cut off valve of standard construction which when in open or on position permits the flow of gas through the conduit 3 from the manifold to the burner 1, and in closed or off position cuts off flow of gas to the burner 1. This valve is manually opened and closed by a handle 7 and a valve stem 8, and directly controls the operation of the entire apparatus in that it initiates the operation of the entire apparatus when it is turned to the on position and terminates the operation when it is turned to the off position. From the main control valve 4 gas flows through a connector 9 to the safety control valve mechanism 5, to be described in detail hereinafter. From the safety control valve mechanism 5 the gas flows through a connector 10, the oven temperature control valve 6 and the conduit 3 to the burner 1. The oven temperature control valve 6 is operative to regulate the amount of gas flowing to the burner 1 in order to maintain the oven at any desired set temperature. The valve 6 is set to any desired temperature by a handle 11 having a pointer 12 which cooperates with a graduated dial 13 carried by the valve 6. The valve 6 is controlled according to the temperature setting by a thermostatic element 14 which is mounted in the oven 2 and is connected to the valve 6 as shown at 15. The oven temperature control valve 6 is of standard well known construction. Consequently it is not shown in detail herein. There are many different constructions available any one of which will work equally well herein. Gas is also supplied to a pilot burner 16 through a branch conduit 17 which extends between the safety control valve mechanism and the pilot burner 16. The pilot burner 16 is disposed adjacent the rear end of the main burner 1 in position to ignite the burner 1 when gas is supplied thereto. An electrical ignition element 18 is operatively associated with the pilot burner 16 in position to ignite the pilot burner 16 when gas is supplied thereto. A thermostatic element 19 and a thermocouple 20 are mounted in position to be heated by a flame from the pilot burner. The thermostatic element 19 is operative to open and close a switch 21 which controls the energization of the electrical ignition element 18

and a solenoid 22 which when energized operates the safety control valve mechanism to supply gas to the pilot burner 16 as will be described in connection with the description of the safety control valve mechanism and the operation of the whole apparatus. The thermocouple 20 when heated is operative to hold the safety control valve mechanism in condition to maintain the supply of gas to both the pilot burner 16 and the main burner 1, as will also be described in connection with the description of the safety control valve mechanism and the operation of the apparatus. A switch mechanism 23 which is associated with the main control valve 4 is adapted to be opened and closed simultaneously with the closing and opening of the main control valve 4. As the control valve 4 is turned from the off or closed position to the on or opened position the switch mechanism 23 is moved from the open position to the closed position by an operating lever 24 which cooperates with a cam section 25 on the main control valve stem 8. Conversely, when the main control valve 4 is turned from the open or on position to the closed or off position the switch mechanism 23 is moved from the closed position to the open position.

An electric circuit between the thermocouple 20 and the safety control valve mechanism 5 is established by a copper tube 26 which encloses an insulated wire 27. The wire 27 is severed between the thermocouple 20 and the safety control mechanism 5 and an interrupter 28 having terminals 29 and 30 is interposed between the severed ends. One of the severed ends of the wire 27 is connected to the terminal 29 and the other severed end is connected to the terminal 30. The purpose and function of the interrupter 28 will be explained in detail in connection with the description of the operation of the apparatus.

The construction of the safety control valve mechanism 5 and its connection to the solenoid 22 will now be described, reference being had to Figs. 2, 3 and 4 of the drawing. This mechanism comprises a casing 35 having a chamber 36 in one end thereof and a chamber 37 in the other end thereof. The chambers 36 and 37 are connected by a bore 38 of reduced diameter. A valve seat 39 is located at one end of the bore 38 and a similar valve seat 40 is located at the other end of the bore 38. The chamber 36 is closed by a removable cap 41 and the chamber 37 is closed by a removable cap 42. A sleeve 43, having end walls 44 and 45, is carried by the cap 41 and extends into the chamber 36. A valve stem 46 which is slidably mounted in a bushing 47 carried by the end wall 45 of the sleeve 43, extends from the chamber 36 into the sleeve 43. A valve disc 48 of suitable material is secured to one end of the valve stem 46 within the chamber 36, and a metal disc 49 is secured to the other end of the stem 46 within the sleeve 43. A spring 50 disposed about the valve stem 46 between the valve disc 48 and the end wall 45 of the sleeve 43 normally holds the valve disc 48 against the valve seat 39. A horseshoe magnet 51 is secured to one end of a hollow exteriorly threaded stud 52 which extends out through aligned apertures in the end wall 44, of the sleeve 43, and in the end of the cap 41. A nut 53 screwed onto the outer portion of the stud 52 securely holds the magnet 51 and the sleeve 43 in place. The legs of the magnet 51 have a winding 54 thereon one end of which is connected to the tube 26 and the other end of which is connected to the wire 27 in the

tube 26. The tube 26 is inserted into the hollow stud 52 and is held in place by a screw fitting 52a. A sleeve 55 is screwed into a threaded recess in the end of the cap 42, as indicated at 56, and extends into the chamber 37 a slight distance. One end of the sleeve 55 is closed by an end wall 57, and the other end which is open registers with a circular aperture 58 in the end wall of the cap 42. A plug 59 is slidably mounted in the sleeve 55 and extends out through the aperture 58 in the cap 42. The outer end of the plug 59 has a reduced extension 60 formed integral therewith, providing an annular shoulder 61 around the extension 60 at the outer end of the plug 59. A stem 62 which is secured to the inner end of the plug 59 extends out through an aperture 63, in the end wall 57 of the sleeve 55, and through the chamber 37 and into the bore 38. The stem 62 has a collar 64 rigidly secured thereon between the end wall 57 and the outer end of the stem. A valve disc 65 of suitable material is slidably mounted upon the stem 62 between the end wall 57 of the sleeve 55 and the collar 64. The valve disc 65 is adapted to engage the valve seat 40 to cut off the flow of gas into the chamber 37 during the initiation of operation as will be hereinafter described. A compression spring 66 disposed about the stem 62 between the end wall 57 and the valve disc 65 normally yieldingly holds the valve disc 65 against the collar 64. A compression spring 67 which is stronger than the spring 66 is disposed about the stem 62 within the sleeve 55 between the inner face of the end wall 57 and the inner end of the plug 59. The spring 67 is operative to return the plug 59, stem 62 and valve disc 65 from the position shown in Fig. 3 back to their normal position as shown in Fig. 2, against the resistance of the spring 66. A port 68 in the casing 35 provides communication between the chamber 36 and the connector 9 to allow gas to flow from the main control valve 4 through the connector 9 and into the chamber 36. During normal operation of the main burner 1 gas flows from the chamber 36 through the reduced intermediate bore 38 and into the chamber 37. A port 69 which establishes communication between the conduit 17 and the bore 38 is provided to supply gas to the pilot burner 16; and a port 70 establishes communication between the chamber 37 and the connector 10 to permit the flow of gas from the chamber 37 to the main burner 1 through the oven temperature control valve and the conduit 3.

The safety control valve mechanism 5 is operatively connected to the solenoid 22 by a yoke 72 and a link 73. The yoke 72 which encompasses the safety control valve mechanism 5 as shown in Fig. 4 comprises a pair of spaced parallel arms 74 which are connected together at one end by a bridge 75. The bridge 75 has an aperture 76 therein through which the reduced end 60 of the plug 59 extends with the inner face of the bridge engaging the shoulder 61 between the plug 59 and the reduced extension 60 thereof. The other ends of the arms 74 terminate in a pair of spaced parallel ears 77 to and between which one end of the link 73 is pivotally connected. The other end of the link 73 is pivotally connected to the movable core 78 of the solenoid 22 as indicated at 79.

The switch mechanism 23 consists of the master control switch 80 and the interrupter switch 81. The master control switch 80 comprises the contacts 82 and 83 which are adapted to be bridged by the conductor bar 84; and the interrupter switch 81 comprises the contacts 85 and 86 which are adapted to be bridged by the conductor bar 87. The switch 21 comprises three contacts 88, 89 and 90 which are adapted to be bridged by a conductor bar 91 when the switch is in its normal closed position.

The supplemental master switch which is shown at 92 in Fig. 6 comprises the contacts 93 and 94 which are adapted to be bridged by a conductor bar 95; and the supplemental interrupter switch which is shown at 96 in Fig. 6 comprises the contacts 97 and 98 which are adapted to be bridged by a conductor bar 99. The conductor bars 95 and 99 are mounted on a base 100, of insulating material, which is adapted to be moved toward and away from the contacts 93, 94, 97 and 98 at predetermined times by a time control mechanism 101 through a connecting link 102. When it is desired to operate the oven burner of a range which is equipped with a time control independently of the time control mechanism, the switches 92 and 96 are locked in closed position through the medium of a manually operable button 103 incorporated in the time control mechanism 101.

The operation of the apparatus will now be described in connection with Fig. 5 which is a wiring diagram showing the electrical circuits of our improved ignition and control apparatus without a time control mechanism incorporated therein. To initiate the operation of the oven burner 1 it is only necessary to set the oven temperature control valve 6 to the desired temperature and to manually turn the main control valve 4 from the off position to the on position. After that the ignition and operation of the burner are automatically controlled until the operation of the burner is terminated by manually turning the main control valve 4 from the on position to the off position. As the main control valve 4 is turned from the off position to the on position the master switch 80 and the interrupter switch 81 are simultaneously closed by the cam 25 and lever 24. After the main control valve has been opened gas can flow from the manifold through the main control valve 4 and into the chamber 36 of the safety control valve mechanism 5, the various parts of which are in the position shown in Fig. 2. But the gas can go no farther since the valve disc 48 is being held against the valve seat 39 by the spring 50, thus closing the only exit from the chamber 36. As soon as the switch 80 is closed current flows from one side 105 of the line through the lead 106 to the terminal 82 and thence through the conductor bar 84 to the terminal 83. From the terminal 83 the current flows through the lead 107 to the terminal 88 of the normally closed switch 21, and thence through the conductor bar 91 to the terminals 89 and 90. From the terminal 89 the current flows through the lead 108 to the electrical resistance ignition element 18, thence through the ignition element 18 and back to the other side 109 of the line through the lead 110, thus completing a circuit through the ignition element 18 which energizes it and renders it operable to ignite the pilot burner 16 as soon as gas is supplied thereto. From the terminal 90 of the normally closed switch 21 the current also flows through the lead 111 to the solenoid 22, thence through the winding of the solenoid and back to the other side 109 of the line through the lead 112, thus completing a circuit which energizes the solenoid 22. The energization of the solenoid 22 causes it, through the link 73 and yoke 72, to

shift the various parts of the safety control valve mechanism from the position shown in Fig. 2 to the position shown in Fig. 3. In this position the valve disc 48 is held away from the valve seat 39 and the metal disc 49 is held against the ends of the legs of the magnet 51 by stem 62 acting against the resistance of the spring 50. This allows gas to flow from the chamber 36 into the bore 38 and thence through the port 69 and conduit 17 to the pilot burner 16 where it is ignited by the ignition element 18. But the gas cannot yet flow to the main burner 1 since the valve disc 65 is being held against the seat 40 by the spring 66 which cuts off communication between the bore 38 and the chamber 37. As soon as the pilot burner 16 is ignited it projects a flame against and heats both the thermocouple 20 and the thermostatic element 19. The heating of the thermocouple 20 generates a minute current which energizes the magnet 51 sufficiently for it to hold the metal disc 49 and the stem 46 and valve disc 48 secured thereto in the position shown in Fig. 3 against the pressure of the spring 50 after the disc 49 has been moved into engagement with the magnet 51 by the solenoid 22. But the magnet 51 when energized by the thermocouple 20 is not strong enough to attract and withdraw the metal disc 49, and the stem 46 and valve disc 48 secured thereto, from the position shown in Fig. 2 to the position shown in Fig. 3. It can only hold these parts in this position after they have been moved thereto by the solenoid 22 through the medium of the link 73, yoke 72, plunger 59 and stem 62. The electric circuit between the thermocouple 20 and the winding 54 of the magnet 51 is through the copper tube 26, which extends unbroken between the thermocouple 20 and the winding 54, and the wire 27 which is severed between the winding 54 and the thermocouple 20. One of the severed ends of the wire 27 is connected to the terminal 29 of the interrupter 28, and the other severed end of the wire 27 is connected to the terminal 30 of the interrupter 28. The terminal 29 is connected to the contact 85 of the interrupter switch 81 by a lead 115, and the terminal 30 is connected to the terminal 86 of the interrupter switch 81. Current generated by the thermocouple will then flow from the thermocouple 20 through the tube 26 to and through the winding 54. From the winding 54 the current will flow back through the wire 27 to the terminal 29. From the terminal 29 the current will flow through lead 115 to and through the switch 81, and back to the terminal 30 through the lead 116. From the terminal 30 the current will flow back to the thermocouple 20 through the other section of the wire 27, completing the circuit between the thermocouple 20 and the winding 54 of the magnet 51. This circuit will be maintained as long as the thermocouple is heated. After the thermostatic element 19 has been heated sufficiently, which is after the thermocouple has energized the magnet 51, it will open the normally closed switch 21, breaking the circuit to and de-energizing both the ignition element 18 and the solenoid 22. After the pilot burner has been ignited there is no further need to maintain the ignition element energized. As soon as the solenoid 22 is de-energized the spring 67 will return the plunger 59, stem 62 and valve disc 65 back from the position shown in Fig. 3 to the position shown in Fig. 2 against the pressure of the spring 66. The valve disc 48 will be held in the position shown in Fig. 3 by the magnet 51. Communication is then established between the chambers 36 and 37 through the bore 38. Gas will then flow from the chamber 36 into the chamber 37 through the bore 38. From the chamber 37 gas will flow through the oven temperature control valve 6 and conduit 3 to the main burner 1 where it will be ignited by the pilot burner 16. The apparatus is now operating normally, and in the absence of any abnormal conditions it will continue to do so, provided the pilot burner remains ignited, until the supply of gas to both the pilot burner and the main burner is cut off by the manual closing of the main control valve 4.

In the event the pilot burner 16 is extinguished for any reason during operation, the thermocouple 20 will cool in a few seconds and de-energize the magnet 51. The de-energizing of the magnet 51 will allow the spring 50 to move the valve disc 48 back into engagement with the valve seat 39, as shown in Fig. 2, which will cut off the flow of gas from the chamber 36 into the bore 38 and chamber 37, and from them to the pilot light 16 and the main burner 1. The burner 1 will then be extinguished along with the pilot burner. As soon as the thermostatic element 19 cools it will close the switch 21 which will energize both the ignition element 18 and the solenoid 22 as previously described since the main control valve 4 is still open and the switches 80 and 81 are closed. The pilot burner 16 will then be reignited and the rest of the apparatus will again function as described, provided there is gas available. If no gas is available everything will remain in condition to ignite the pilot burner and re-initiate operation as soon as gas is again available. In the event of either a momentary or prolonged power failure during operation, the apparatus will continue to operate normally until terminated by the manual closing of the main control valve, provided of course that all other conditions are normal. In order to operate the apparatus during a prolonged power failure which occurred prior to operation, it is only necessary to hold a match to the pilot burner 16 and manually move the plunger 59 from the position shown in Fig. 2 to the position shown in Fig. 3 and hold it in this position a sufficient time for the thermocouple 20 to become heated, after which the plunger 59 may be released and allowed to be returned to its initial position by the spring 67. The apparatus will then continue to function normally as described under the control of the pilot burner 16 and the oven temperature control valve 6. When the time control mechanism 101 is incorporated in the apparatus as shown in Fig. 6, we interpose the supplemental master switch 92 in the lead 107, between the contact 83 of the master switch 80 and the contact 88 of the normally closed thermostatically operated switch 21, in series with the master switch 80; and we interpose the supplemental interrupter switch 96 in the lead 116, between the contact 97 of the interrupter switch 96 and the terminal 30 of the interrupter 28, in series with the interrupter switch 96. The time control mechanism when used is operative to close the switches 92 and 96 at a predetermined set time and to open the switches at a predetermined set later time. After the switches 92 and 96 have been closed the mechanism functions in exactly the same manner as described in connection with Fig. 5, until at the predetermined set later time the time control mechanism opens the swtiches 92 and 96 which terminates

the operation just as effectively as if the main control valve had been turned off. The opening of the supplemental master switch 92 by the time control mechanism at the predetermined later time has no effect upon the operation of the apparatus; but the opening of the supplemental interrupter switch 96 breaks the circuit between the thermocouple 20 and the safety control valve mechanism which de-energizes the magnet 51 and allows the spring 50 to move the valve disc 48 from the position shown in Fig. 3 into engagement with the valve seat 39 as shown in Fig. 2. This closes the exit from the chamber 36 and completely cuts off the supply of gas to both the main burner 1 and the pilot burner 16. The main control valve 4 can then be manually closed at any time after the time control mechanism has terminated operation. Operation cannot again be initiated until the main control valve 4 is opened and the switches 80, 81, 92 and 96 are closed.

As previously stated, it frequently happens that after the apparatus has been in operation for some time the operator turns the main control valve off and then immediately turns it on again before the thermocouple 20 and the thermostatic element have had an opportunity to cool. The closing of the main control valve 4 cuts off the supply of gas to and extinguishes both the main burner 1 and the pilot burner 16. Under this condition, if the interrupter switch 81 was not interposed in the circuit between the thermocouple 20 and the safety control valve mechanism 5 and arranged to be opened and closed by the closing and opening of the main control valve 4, unburned gas would escape into the oven from both the pilot burner and the main burner until the thermocouple cooled and cut off the supply of gas to both burners as previously described. During this time sufficient gas could accumulate in the oven to cause a bad explosion when the pilot burner 16 or the main burner 1 were again ignited. Therefore we provide the interrupter switch 81 in order to prevent any escape of unburned gas when this condition occurs. With the interrupter switch 81 arranged as shown and described the momentary closing of the main control valve 4 will simultaneously open the interrupter switch 81. The opening of the interrupter switch 81 will break the circuit between the thermocouple 20 and the safety control valve mechanism and de-energize the magnet 51 even though the thermocouple is still hot. The de-energization of the magnet 51 allows the spring 50 to move the valve disc 48 into position to cut off the supply of gas to both the main burner and the pilot burner as previously described. The immediate opening of the control valve 4 under this condition will have no effect upon the apparatus until the thermostatic element 19 cools and closes the switch 21. This is due to the fact that the magnet 51 when energized is not strong enough to shift the valve disc 48 and the connected parts from the closed position shown in Fig. 2 to the open position shown in Fig. 3, but can only hold them in this position after they have been moved there by the solenoid 22. After the thermostatic element 19 cools and closes the switch 21, which takes from six to ten seconds, the ignition element 18 and the solenoid 22 are again energized after which the operation proceeds as previously described.

Operating current is supplied to the time control mechanism 101 from the line 105—109 by the leads 117 and 118.

From the foregoing it will be seen that in the event the pilot burner is extinguished for any reason the supply of gas to both the main burner and the pilot burner will be completely cut off, thus eliminating all possibility of an explosion due to an accumulation of unburned gas; and it will be apparent to those skilled in this art that we have provided a very simple and efficient apparatus for accomplishing the objects of the invention.

It is to be understood that we are not limited to the specific construction shown and described herein as various modifications may be made therein within the scope of the appended claims.

What is claimed is:

1. In an automatic ignition and control apparatus of the character described, the combination of a main burner, a pilot burner operative to ignite said main burner, a conduit through which gaseous fuel is supplied to said main burner, a manually operable main control valve by which the supply of fuel to said main burner and said pilot burner is primarily controlled, a safety control valve mechanism interposed in said conduit between said main control valve and said main burner, a secondary conduit extending between said safety control valve mechanism and said pilot burner through which gaseous fuel is supplied to said pilot burner, said safety control valve mechanism being operative to control the supply of fuel to said main burner and said pilot burner after the fuel leaves said main control valve, a solenoid operatively connected to said safety control valve mechanism, said solenoid being operative upon energization to set said safety control valve mechanism in condition to supply fuel to said pilot burner while cutting off the supply of fuel to said main burner and upon subsequent de-energization to set said safety control valve mechanism in condition to also supply fuel to said main burner, a normally closed switch operative to control the energization of said solenoid, and a thermostatic element adapted to be heated by said pilot burner and operative to maintain said switch open when heated and closed when cool.

2. In an automatic ignition and control apparatus of the character described, the combination of a main burner, a pilot burner operative to ignite said main burner, a conduit through which gaseous fuel is supplied to said main burner, a manually operable main control valve by which the supply of fuel to said main burner and said pilot burner is primarily controlled, a safety control valve mechanism interposed in said conduit between said main control valve and said main burner, a secondary conduit extending between said safety control valve mechanism and said pilot burner through which gaseous fuel is supplied to said pilot burner, said safety control valve mechanism being operative to control the supply of fuel to said main burner and said pilot burner after the fuel leaves said main control valve, a solenoid operatively connected to said safety control valve mechanism, said solenoid being operative upon energization to set said safety control valve mechanism in condition to supply fuel to said pilot burner while cutting off the supply of fuel to said main burner and upon subsequent de-energization to set said safety control valve mechanism in condition to also supply fuel to said main burner, a normally open master switch which is operative when closed to energize said solenoid, a normally closed switch which is operative when opened to de-energize said solenoid, and a thermostatic element

adapted to be heated by said pilot burner and operative when heated to maintain said normally closed switch open and when cool to maintain said normally closed switch closed.

3. In an automatic ignition and control apparatus of the character described, the combination of a main burner, a pilot burner operative to ignite said main burner, an electric ignition element operative when energized to ignite said pilot burner, a conduit through which gaseous fuel is supplied to said main burner, a manually operable main control valve by which the supply of fuel to said main burner and said pilot burner is primarily controlled, a safety control valve mechanism interposed in said conduit between said main control valve and said main burner, a secondary conduit extending between said safety control valve mechanism and said pilot burner through which gaseous fuel is supplied to said pilot burner, said safety control valve mechanism being operative to control the supply of fuel to said main burner and said pilot burner after the fuel leaves said main control valve, a solenoid operatively connected to said safety control valve mechanism, said solenoid being operative upon energization to set said safety control valve mechanism in condition to supply fuel to said pilot burner while cutting off the supply of fuel to said main burner and upon subsequent de-energization to set said safety control valve mechanism in condition to also supply fuel to said main burner, a normally open master switch associated with said main control valve, operative connections between said main control valve and said master switch through which said master switch is closed by the opening of said main control valve and is opened by the closing of said main control valve, said master switch being operative when closed to energize said solenoid and said electric ignition element, a normally closed switch disposed in series with said master switch which is operative when opened to de-energize said solenoid and said electric ignition element, a thermostatic element adapted to be heated by said pilot burner and operative when heated to maintain said normally closed switch open and when cool to maintain said normally closed switch closed.

4. In an automatic ignition and control apparatus of the character described, the combination of a main burner, a pilot burner operative to ignite said main burner, a conduit through which gaseous fuel is supplied to said main burner, a manually operable main control valve by which the supply of fuel to said main burner and said pilot burner is primarily controlled, a safety control valve mechanism interposed in said conduit between said main control valve and said main burner and operative to control the supply of fuel to said main burner and said pilot burner after the fuel leaves said main control valve, a secondary conduit extending between said safety control valve mechanism and said pilot burner through which gaseous fuel is supplied to said pilot burner, said safety control valve mechanism including a normally open valve and a normally closed valve, a solenoid operatively connected to said safety control valve mechanism, said solenoid being operative upon energization to close said normally open valve and to open said normally closed valve and upon subsequent de-energization to reopen said normally open valve, a thermocouple adapted to be heated by said pilot burner and operative when heated to maintain said normally closed valve open after it has been

opened by the action of said solenoid whereby fuel is first supplied to said pilot burner and then upon the subsequent de-energization of said solenoid fuel is supplied to both said pilot burner and said main burner, a normally open master switch which is operative when closed to energize said solenoid, a normally closed switch which is operative when opened to de-energize said solenoid, and a thermostatic element adapted to be heated by said pilot burner and operative when heated to maintain said normally closed switch open and when cool to maintain said normally closed switch closed.

5. In an automatic ignition and control apparatus of the character described, the combination of a main burner, a pilot burner operative to ignite said main burner, an electric ignition element operative when energized to ignite said pilot burner, a conduit through which gaseous fuel is supplied to said main burner, a manually operable main control by which the supply of fuel to said main burner and said pilot burner is primarily controlled, a safety control valve mechanism interposed in said conduit between said main control valve and said main burner and operative to control the supply of fuel to said main burner and said pilot burner after the fuel leaves said main control valve, a secondary conduit extending between said safety control valve mechanism and said pilot burner through which gaseous fuel is supplied to said pilot burner, said safety control valve mechanism including a normally open valve and a normally closed valve, a solenoid operatively connected to said safety control valve mechanism, said solenoid being operative upon energization to close said normally open valve and to open said normally closed valve and upon subsequent de-energization to reopen said normally open valve, a thermocouple adapted to be heated by said pilot burner and operative when heated to maintain said normally closed valve open after it has been opened by the action of said solenoid whereby fuel is first supplied to said pilot burner and then upon the subsequent de-energization of said solenoid fuel is supplied to both said pilot burner and said main burner, a normally open master switch associated with said main control valve, operative connections between said main control valve and said master switch through which said master switch is closed by the opening of said main control valve and is opened by the closing of said main control valve, said master switch being operative when closed to energize said solenoid and said electric ignition element, a normally closed switch disposed in series with said master switch which is operative when opened to de-energize said solenoid and said electric ignition element, a thermostatic element adapted to be heated by said pilot burner and operative when heated to maintain said normally closed switch open and when cool to maintain said normally closed switch closed.

6. In an automatic ignition and control apparatus of the character described, the combination of a main burner, a pilot burner operative to ignite said main burner, a conduit through which gaseous fuel is supplied to said main burner, a manually operable main control valve by which the supply of fuel to said main burner and said pilot burner is primarily controlled, a safety control valve mechanism interposed in said conduit between said main control valve and said main burner, a secondary conduit extending between said safety control valve mechanism and said

pilot burner through which gaseous fuel is supplied to said pilot burner, said safety control valve mechanism being operative to control the supply of fuel to said main burner and said pilot burner after the fuel leaves said main control valve, a solenoid operatively connected to said safety control valve mechanism, said solenoid being operative upon energization to set said safety control valve mechanism in condition to supply fuel to said pilot burner while cutting off the supply of fuel to said main burner and upon subsequent de-energization to set said safety control valve mechanism in condition to also supply fuel to said main burner, an electromagnet associated with said safety control valve mechanism and operative when energized to maintain said safety control valve mechanism in said set condition, a thermocouple adapted to be heated by said pilot burner, an electric circuit between said thermocouple and said electromagnet through which said magnet is energized by said thermocouple when heated, an interrupter switch interposed in said circuit and operative to open and close said circuit and thereby control the energization of said electromagnet, a normally open master switch which is operative when closed to energize said solenoid, a normally closed switch which is operative when opened to de-energize said solenoid, and a thermostatic element adapted to be heated by said pilot burner and operative when heated to maintain said normally closed switch open and when cool to maintain said normally closed switch closed.

7. In an automatic ignition and control apparatus of the character described, the combination of a main burner, a pilot burner operative to ignite said main burner, an electric ignition element operative when energized to ignite said pilot burner, a conduit through which gaseous fuel is supplied to said main burner, a manually operable main control valve by which the supply of fuel to said main burner and said pilot burner is primarily controlled, a safety control valve mechanism interposed in said conduit between said main control valve and said main burner, a secondary conduit extending between said safety control valve mechanism and said pilot burner through which gaseous fuel is supplied to said pilot burner, said safety control valve mechanism being operative to control the supply of fuel to said main burner and said pilot burner after the fuel leaves said main control valve, a solenoid operatively connected to said safety control valve mechanism, said solenoid being operative upon energization to set said safety control valve mechanism in condition to supply fuel to said pilot burner while cutting off the supply of fuel to said main burner and upon subsequent de-energization to set said safety control valve mechanism in condition to also supply fuel to said main burner, an electromagnet associated with said safety control valve mechanism and operative when energized to maintain said safety control valve mechanism in said set condition, a thermocouple adapted to be heated by said pilot burner, an electric circuit between said thermocouple and said electromagnet through which said electromagnet is energized by said thermocouple when heated, an interrupter switch interposed in said circuit and operative to open and close said circuit and thereby control the energization of said electromagnet, a normally open master switch associated with said main control valve, operative connections between said main control valve and said master switch through which said master switch is closed by the opening of said main control valve and is opened by the closing of said main control valve, said master switch being operative when closed to energize said solenoid and said electric ignition element, a normally closed switch disposed in series with said master switch which is operative when opened to de-energize said solenoid and said electric ignition element, a thermostatic element adapted to be heated by said pilot burner and operative when heated to maintain said normally closed switch open and when cool to maintain said normally closed switch closed.

8. In an automatic ignition and control apparatus of the character described, the combination of a main burner, a pilot burner operative to ignite said main burner, a conduit through which gaseous fuel is supplied to said main burner, a manually operable main control valve by which the supply of fuel to said main burner is primarily controlled, a safety control valve mechanism interposed in said conduit, a secondary conduit extending between said safety control valve mechanism and said pilot burner through which gaseous fuel is supplied to said pilot burner, said safety control valve mechanism being operative to control the supply of fuel to said main burner after said main control valve has been opened, means through which said safety control valve mechanism is set in condition to supply fuel to said pilot burner and said main burner, an electromagnet associated with said safety control valve mechanism and operative when energized to maintain said safety control valve mechanism in said set condition, a thermocouple adapted to be heated by said pilot burner, an electric circuit between said thermocouple and said electromagnet through which said electromagnet is energized by said thermocouple when heated, an interrupter switch interposed in said circuit and operative to open and close said circuit and thereby control the energization of said electromagnet, said interrupter switch being associated with said main control valve, and operative connections between said main control valve and said interrupter switch through which said interrupter switch is closed by the opening of said main control valve and is opened by the closing of said main control valve.

9. In an automatic ignition and control apparatus of the character described, the combination of a main burner, a pilot burner operative to ignite said main burner, a conduit through which gaseous fuel is supplied to said main burner, a manually operable main control valve by which the supply of fuel to said main burner and said pilot burner is primarily controlled, a safety control valve mechanism interposed in said conduit between said main control valve and said main burner and operative to control the supply of fuel to said main burner and said pilot burner after the fuel leaves said main control valve, a secondary conduit extending between said safety control valve mechanism and said pilot burner through which gaseous fuel is supplied to said pilot burner, said safety control valve mechanism including a normally open valve and a normally closed valve, a solenoid operatively connected to said safety control valve mechanism, said solenoid being operative upon energization to close said normally open valve and to open said normally closed valve and upon subsequent de-energization to reopen said normally open valve, an electromagnet associated with said safety control valve mechanism and operative when

energized to hold said normally closed valve open after it has been opened by the action of said solenoid whereby fuel is first supplied to said pilot burner only and then upon the subsequent de-energization of said solenoid fuel is supplied to both pilot burner and said main burner, a thermocouple adapted to be heated by said pilot burner, an electric circuit between said thermocouple and said electromagnet through which said electromagnet is energized by said thermocouple when heated, an interrupter switch interposed in said circuit and operative to open and close said circuit and thereby control the energization of said electromagnet, said interrupter switch being associated with said main control valve, and operative connections between said main control valve and said interrupter switch through which said interrupter switch is closed by the opening of said main control valve and is opened by the closing of said main control valve.

10. In an automatic ignition and control apparatus of the character described, the combination of a main burner, a pilot burner operative to ignite said main burner, a conduit through which gaseous fuel is supplied to said main burner, a manually operable main control valve by which the supply of fuel to said main burner is primarily controlled, a safety control valve mechanism interposed in said conduit, a secondary conduit extending between said safety control valve mechanism and said pilot burner through which gaseous fuel is supplied to said pilot burner, said safety control valve mechanism being operative to control the supply of fuel to said main burner after said main control valve has been opened, means through which said safety control valve mechanism is set in condition to supply fuel to said pilot burner and said main burner, an electromagnet associated with said safety control valve mechanism and operative when energized to maintain said safety control valve mechanism in said set condition, a thermocouple adapted to be heated by said pilot burner, an electric circuit between said thermocouple and said electromagnet through which said magnet is energized by said thermocouple when heated, an interrupter switch interposed in said circuit and operative to open and close said circuit and thereby control the energization of said electromagnet, operative connections between said main control valve and said interrupter switch through which said interrupter switch is closed by the opening of said main control valve and is opened by the closing of said main control valve, a supplemental interrupter switch interposed in said circuit in series with said interrupter switch, and a time control mechanism operative to close and open said supplemental interrupter switch at predetermined set times.

11. In an automatic ignition and control apparatus of the character described, the combination of a main burner, a pilot burner operative to ignite said main burner, an electric ignition element operative when energized to ignite said pilot burner, a conduit through which gaseous fuel is supplied to said main burner, a manually operable main control valve by which the supply of fuel to said main burner and said pilot burner is primarily controlled, a safety control valve mechanism interposed in said conduit between said main control valve and said main burner, a secondary conduit extending between said safety control valve mechanism and said pilot burner through which gaseous fuel is supplied to said pilot burner, said safety control valve mechanism being operative to control the supply of fuel to said main burner and said pilot burner after the fuel leaves said main control valve, a solenoid operatively connected to said safety control valve mechanism, said solenoid being operative upon energization to set said safety control valve mechanism in condition to supply fuel to said pilot burner while cutting off the supply of fuel to said main burner and upon subsequent de-energization to set said safety control valve mechanism in condition to also supply fuel to said main burner, an electromagnet associated with said safety control valve mechanism and operative when energized to maintain said safety control valve in said set condition, a thermocouple adapted to be heated by said pilot burner, an electric circuit between said thermocouple and said electromagnet through which said magnet is energized by said thermocouple when said thermocouple is heated, an interrupter switch interposed in said circuit and operative to make and break the circuit between said thermocouple and said electromagnet and thereby control the energization of said electromagnet, operative connections between said main control valve and said interrupter switch through which said interrupter switch is closed and opened by the opening and closing of the main control valve, a normally open master switch associated with said main control valve, operative connections between said main control valve and said master switch through which said master switch is closed by the opening of said main control valve and is opened by the closing of said main control valve, said master switch being operative when closed to energize said solenoid and said electric ignition element, a normally closed switch disposed in series with said master switch which is operative when opened to de-energize said solenoid and said electric ignition element, a thermostatic element adapted to be heated by said pilot burner and operative when heated to maintain said normally closed switch open and when cool to maintain said normally closed switch closed, a supplemental master switch disposed in series with said master switch and said normally closed switch, a supplemental interrupter switch interposed in said circuit in series with said interrupter switch, and a time control mechanism operative to simultaneously close and open said supplemental master switch and said supplemental interrupter switch at predetermined set times.

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