Dec. 18, 1951 C. M. MAYER ET AL 2,578,717

BURNER CONTROL MECHANISM

Filed May 23, 1950 5 Sheets-Sheet 1

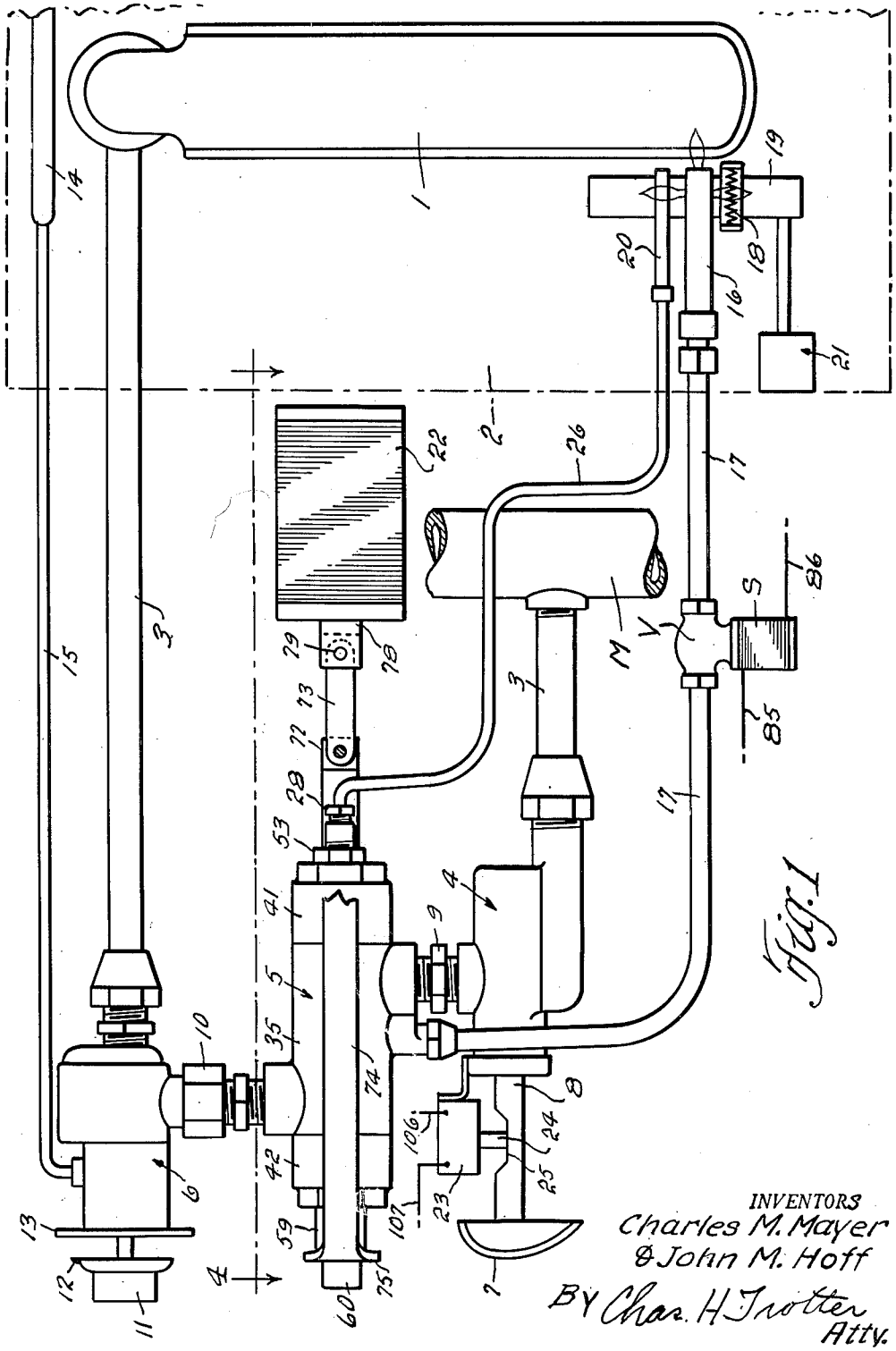


Fig. 1

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Filed May 23, 1950 5 Sheets-Sheet 2

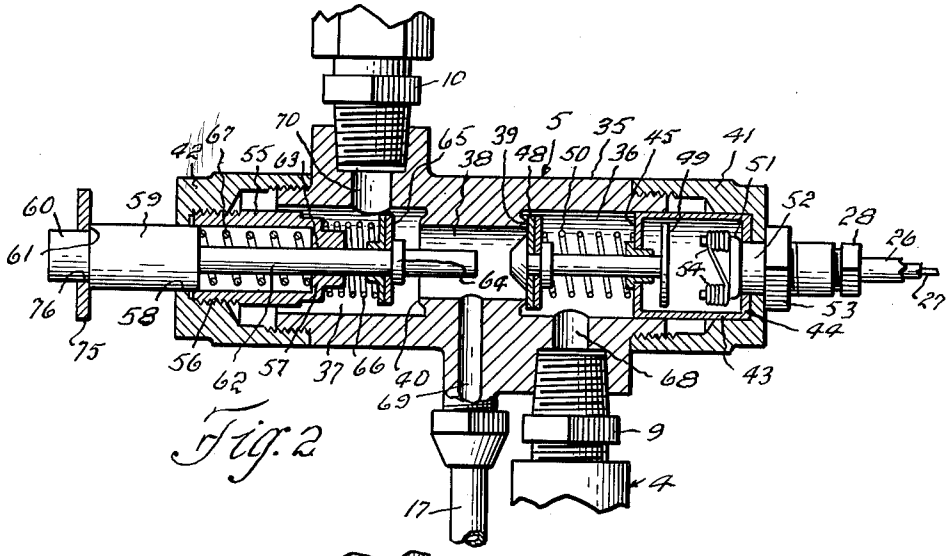


Fig. 2

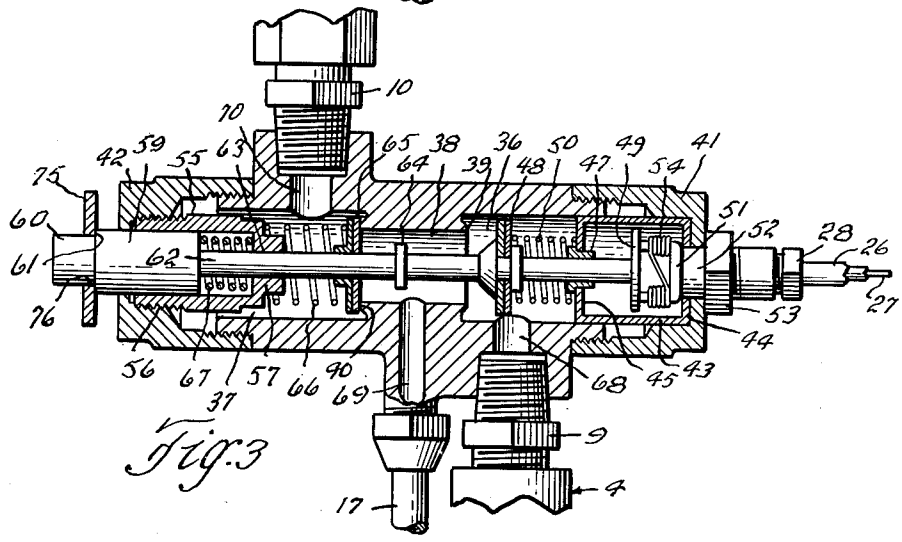


Fig. 3

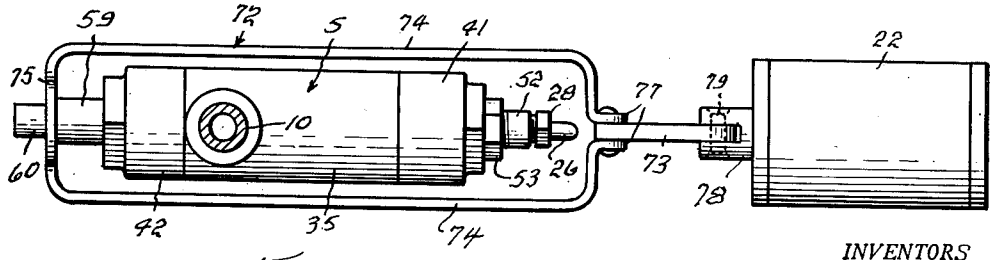


Fig. 4

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BURNER CONTROL MECHANISM

Filed May 23, 1950 5 Sheets-Sheet 3

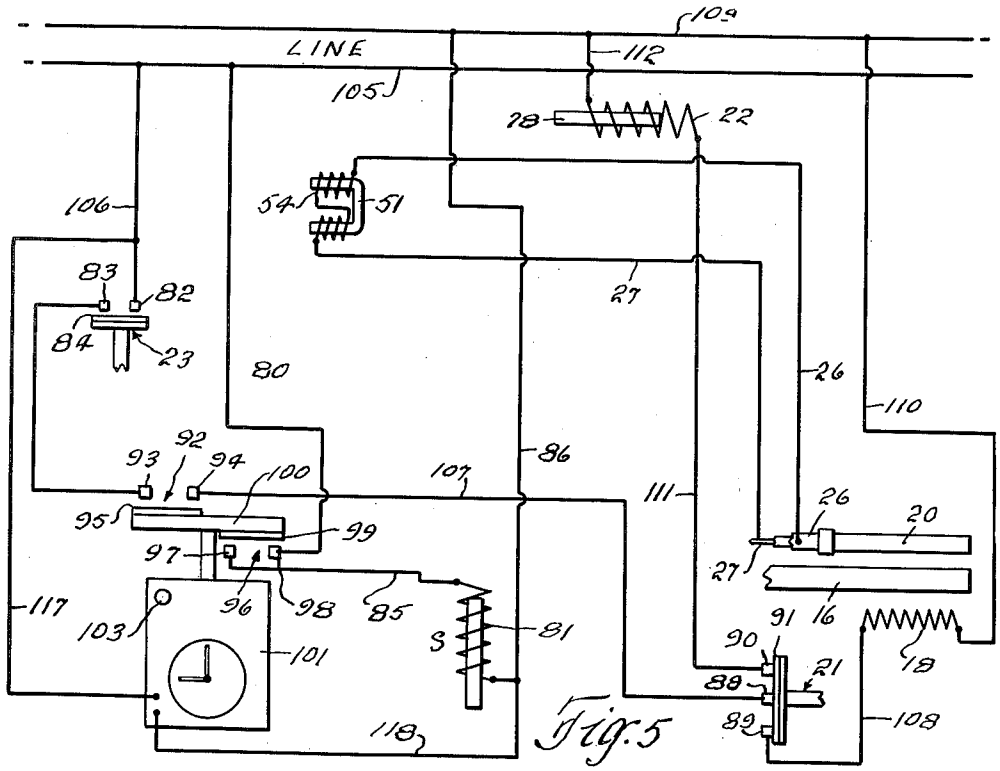


Fig. 5

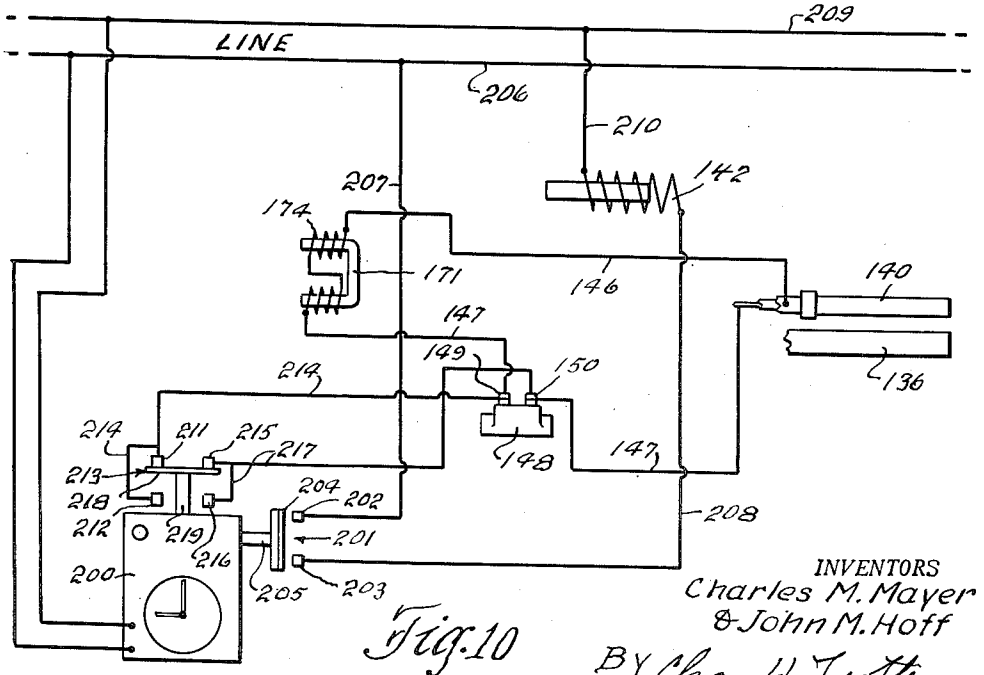


Fig. 10

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BURNER CONTROL MECHANISM

Filed May 23, 1950 5 Sheets-Sheet 4

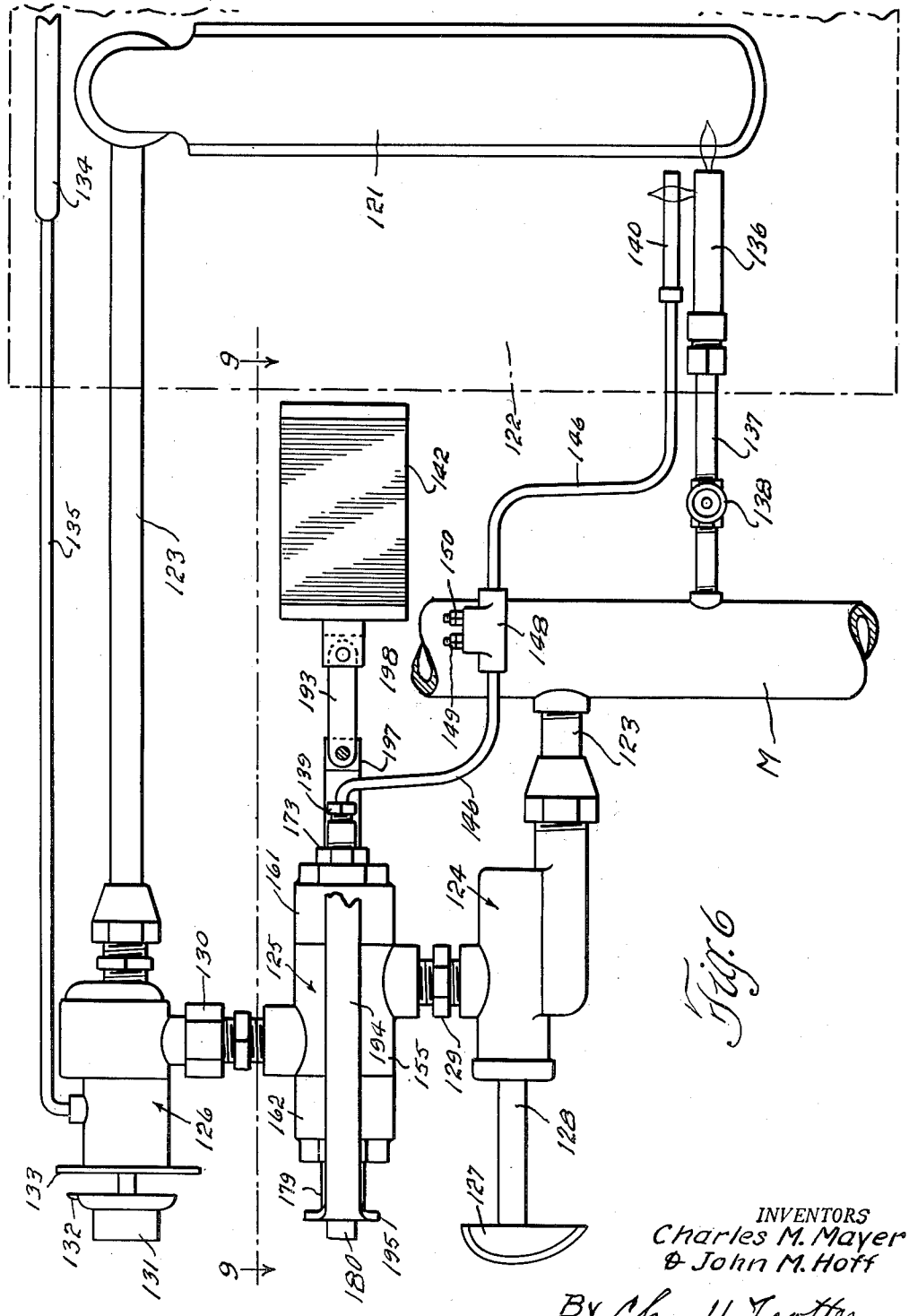


Fig. 6

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BURNER CONTROL MECHANISM

Filed May 23, 1950 5 Sheets-Sheet 5

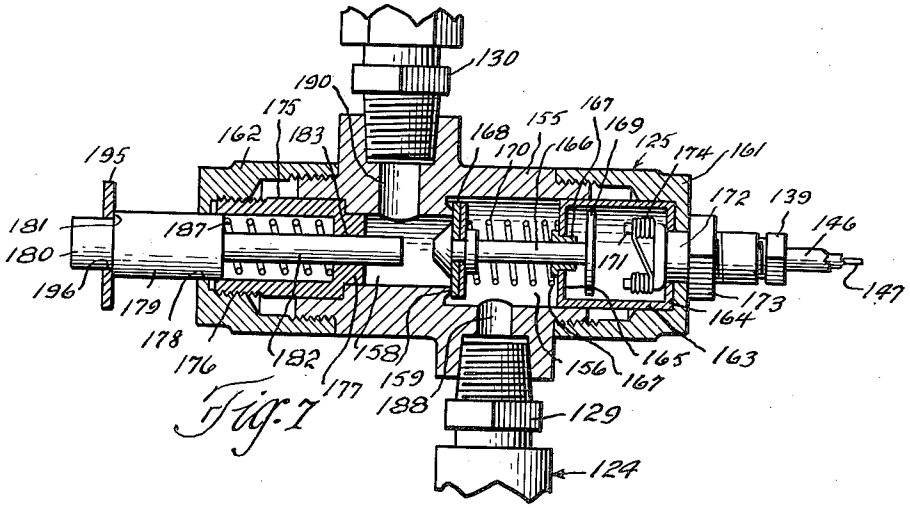


Fig. 7

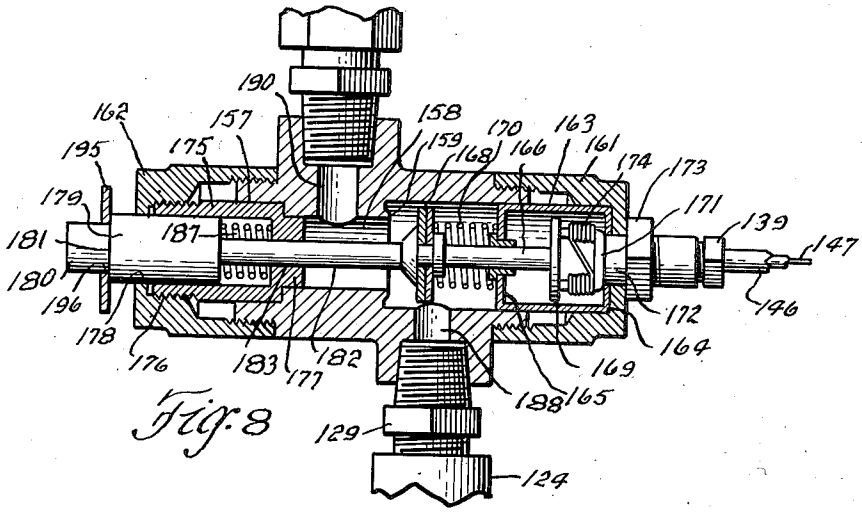


Fig. 8

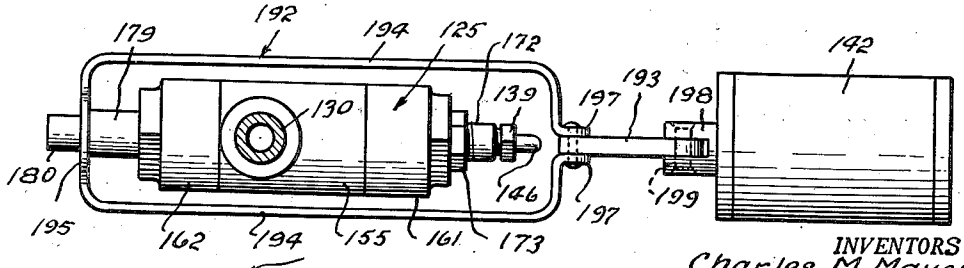


Fig. 9

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UNITED STATES PATENT OFFICE

2,578,717

BURNER CONTROL MECHANISM

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Application May 23, 1950, Serial No. 163,764

12 Claims. (Cl. 161—9)

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This invention relates to automatic control mechanisms for cooking range burners using gaseous fuel, and is a modification of the invention disclosed in our co-pending application, Serial No. 153,664, filed April 3, 1950. It is especially designed and adapted for automatically controlling the operation of oven burners in cooking ranges which are equipped with a time control mechanism.

The mechanism is designed for use with a main gaseous fuel burner which is adapted to be ignited by a gaseous fuel pilot burner. In most cooking ranges in use today it is immaterial whether or not the oven burner burns constantly as long as the pilot burner associated therewith is ignited. 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. 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 an accumulation of unburned gas and thus eliminate danger of an explosion therefrom in the event the pilot burner is extinguished for any reason while the control valve is still open to supply gas to the main burner, we provide in our improved apparatus safety control mechanism by which the supply of gas to the main burner is 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.

One form of our improved apparatus as shown in Figs. 1 to 5 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

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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 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 then 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 manifold 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 reestablish 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 order to accommodate the apparatus for use in conjunction with any standard type time control mechanism, we provide a supplemental master switch and a normally open solenoid valve. The supplemental master switch is inserted in the main circuit in series with the primary master switch and is adapted to be closed at a predetermined time by the time control mechanism. The normally open solenoid valve is inserted in the branch conduit between the safety control valve mechanism and the pilot burner, and is adapted to be closed at a predetermined set time by the time control mechanism. 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 also closes the primary master switch. Then when the supplemental switch which is in series with the primary switch is closed by the time control mechanism the apparatus will function in the same manner as previously described, until the time control mechanism effects the closing of the normally open solenoid valve which cuts off the supply of gas to and extinguishes the pilot burner which in turn causes the safety control valve mechanism to operate to cut off the supply of gas to and thus extinguish the main burner. Means to lock the supplemental switch closed is provided in order that the apparatus may be used independently of the time control mechanism when desired.

Another form of our invention (Figs. 6 to 10) includes a main gaseous fuel oven burner which is adapted to be ignited by a constantly burning pilot burner which is associated therewith. The

supply of gas to the main burner is controlled by a main control valve which is interposed in a conduit between the gas supply manifold and the main burner. When the main control valve is open gas flows from the manifold through the main control valve and into a safety control valve mechanism. From the safety control valve mechanism the gas flows through a standard thermostatically operated oven temperature control valve to the main burner where it is ignited by the pilot burner. Gas is constantly supplied to the pilot burner through a secondary conduit which extends between the manifold and the pilot burner. The pilot burner projects a flame against a thermocouple which is operatively connected to the safety control valve mechanism. As long as the thermocouple is heated by the pilot burner it will energize an electro-magnet which when energized will maintain the safety control valve mechanism in condition to supply gas to the main burner. The oven temperature control valve then regulates the gas flowing from the safety control valve mechanism in order to maintain the desired oven temperature. If during operation the pilot burner is extinguished for any reason the thermocouple will immediately cool which will de-energize the electro-magnet and cause the safety control valve mechanism to cut off the supply of gas to the main burner. The pilot burner must then be manually lighted and after the thermocouple has become heated by the pilot burner the safety control valve mechanism must be manually reset in condition to again supply gas to the main burner. The electro-magnet which is energized by the thermocouple is strong enough to maintain the safety control valve mechanism in set position, but is not strong enough to reset it. Consequently it must be reset manually. After resetting the apparatus will function normally as described as long as the pilot burner is ignited. If during use the main burner is extinguished for any reason it will be immediately reignited by the pilot burner.

In order to accommodate this form of the invention for use with a standard time control mechanism, we provide an interrupter switch in the circuit between the thermocouple and the electro-magnet. We also provide a solenoid which is operative to automatically reset the safety control valve mechanism after the electro-magnet has been de-energized by the momentary opening and closing of the interrupter switch. When used the time control mechanism is first set to initiate operating of the oven main burner at a predetermined time and to terminate operation thereof at a predetermined later time, and then the main control valve is opened. The setting of the time control mechanism momentarily opens and then closes the interrupter switch in the circuit between the thermocouple and the electro-magnet. The momentary opening of the interrupter switch momentarily de-energizes the electro-magnet which causes the safety control valve mechanism to cut off the supply of gas to the main burner. The safety control valve mechanism will remain in this condition until it is reset by the solenoid which is provided for this purpose. At the predetermined set time to initiate operation of the main burner the time control mechanism through a suitable switch will momentarily energize the solenoid which will automatically reset the safety control valve mechanism to supply gas to the main burner where it will be ignited by the constantly burning pilot burner. At the predetermined set later time for

terminating operation of the oven burner the time control mechanism will momentarily open the interrupter switch and de-energize the electro-magnet which will cause the safety control valve mechanism to cut off the supply of gas to the oven burner and terminate operation thereof. When the time control mechanism is not used the interrupter switch is locked in closed position.

The principal object of the invention is to provide an improved 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 an improved automatic control mechanism for a cooking range which is equipped with a constantly burning pilot burner from which the main oven burner is ignited.

Still another object of the invention is to provide an improved 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 one form of our improved 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 of Fig. 1 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 this form of the apparatus as used in conjunction with a time control mechanism.

Fig. 6 is a view similar to Fig. 1 showing another form of the invention;

Fig. 7 is an enlarged central longitudinal vertical section through the safety control valve mechanism of Fig. 6 showing the various parts in position to cut off the supply of gas to the main burner;

Fig. 8 is a view similar to Fig. 7 showing the various parts in position to supply gas to the main burner;

Fig. 9 is a horizontal section taken on the line 9—9 of Fig. 6; and

Fig. 10 is a wiring diagram illustrating the use of the apparatus of Fig. 6 in connection with a time control mechanism.

Referring now to Figs. 1 to 5 of 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 M 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. A normally open valve V which is adapted to be closed by a solenoid S is interposed in the branch conduit 17 between the safety control valve mechanism 5 and the pilot burner 16 for a purpose to be hereinafter described. 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 master switch 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 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 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 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. An electro-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 28. 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 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 6 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 master control switch 23 comprises the contacts 82 and 83 which are adapted to be bridged by the conductor bar 84; and 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 92 which is shown in Fig. 6 comprises the contacts 93 and 94 which are adapted to be bridged by a conductor bar 95; and a switch 96 which is shown in Fig. 6 comprises the contacts 97 and 98 which are adapted to be bridged by a conductor bar 99. The contact 97 of the switch 96 is connected to the side 105 of the line by a lead 80, and the contact 98 of the switch 96 is connected to one end of the winding 81 of the solenoid S by a lead 85. The other end of the winding 81 of the solenoid S is connected to the other side 109 of the line by a lead 86. The switch 96 thus controls the energization of the solenoid S which when energized closes the normally open valve V. 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 independently of the time control mechanism, the switch 92 is locked in closed position and the switch 96 is locked in open position through the medium of a manually operable button 103 incorporated in the time control mechanism 101.

The operation of the apparatus independently of the time control mechanism will now be de-

scribed in connection with Fig. 5. 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 23 is closed by the cam 25 and lever 24. After the main control valve has been opened gas can flow from the manifold M 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 23 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 and the switch 92 which is locked in closed position 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 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 the 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 electro-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 and the wire 27. 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 switch 23 is closed. The pilot burner 16 will then be re-ignited 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 con-

tinue to function normally as described under the control of the pilot burner 16 and the oven temperature control valve 6.

When the apparatus is used in conjunction with the time control mechanism 101 the time control mechanism is set to initiate operation of the main burner 1 at a predetermined time and to terminate operation thereof at a predetermined later time. The setting of the time control mechanism 101 opens the switches 92 and 96 as shown in Fig. 5. Operating current is supplied to the time control mechanism from the line 105—109 by the leads 117 and 118. After the time control mechanism has been set the main control valve 4 is manually opened which closes the master switch 23. Then at the predetermined set time the time control mechanism will close the supplemental switch 92 and establish the circuits to the ignition element 18 and the solenoid 22. The apparatus will then operate as previously described until the time control mechanism terminates operation by closing the switch 96. The closing of the switch 96 energizes the solenoid S which then closes the valve V. The closing of the valve V cuts off the supply of gas to and extinguishes the pilot burner 16. After the pilot burner 16 has been extinguished the thermocouple 20 cools which de-energizes the electro-magnet 51. The safety control valve mechanism will then operate as previously described to cut off the supply of gas to the main burner, thus terminating the operation thereof. The main control valve 4 can then be manually closed at any time.

Referring now to Figs. 6 to 10, inclusive, of the drawing wherein a gaseous fuel burner 121 is shown in an oven 122. Fuel is supplied to the burner 121 from the manifold M by a conduit 123. Interposed in the conduit 123 between the manifold M and the main burner 121 are a main control valve 124, a safety control valve mechanism 125 and an oven temperature control valve 126. The main control valve 124 is a cut-off valve of standard construction which when in open or on position permits the flow of gas from the manifold M to the main burner 121 and when in closed or off position cuts off the flow of gas thereto. This valve is manually opened and closed by a handle 127 secured to the valve stem 128, and primarily controls the operation of the main burner in that it must be turned on to initiate operation of the burner and when it is turned off the burner cannot function. From the main control valve 124 gas flows through a connector 129 to the safety control valve mechanism 125, to be described in detail hereinafter. From the safety control valve mechanism 125 the gas flows through a connector 130 to the oven temperature control valve 126 and from there to the main burner 121. The oven temperature control valve 126 is operative to regulate the amount of gas flowing to the burner 121 in order to maintain the oven at any desired set temperature. The valve 126 is set to maintain any desired temperature by a handle 131 having a pointer 132 which cooperates with a graduated dial 133 carried by the valve 126. The valve 126 is controlled according to the temperature setting by a thermostatic element 134 which is mounted in the oven 122 and is connected to the valve 126 as indicated at 135. The oven temperature control valve 122 is of standard well known construction. Consequently it is not shown and described in detail herein. There are many different types, any one of which will operate equally well herein. Gas is supplied to a constantly burning pilot burner 136 through a small secondary conduit 137 which connects the pilot burner 136 directly to the manifold M. A cut-off valve 138 by which the supply of gas to the pilot burner 136 may be manually cut off if desired is interposed in the conduit 137. The pilot burner 136 is mounted adjacent the rear end of the main burner 121 in position to ignite the main burner 121 whenever gas is supplied thereto. A thermocouple 140 is disposed adjacent the pilot burner 136 in position to be heated by a flame therefrom. The thermocouple 140 is connected to the safety control valve mechanism 135 and is operative when heated to maintain the safety control valve mechanism in condition to supply gas to the main burner 121 when the main control valve is open as will be described in connection with the description of the safety control valve mechanism and the operation of the apparatus. An electric circuit is established between the thermocouple 140 and the safety control valve mechanism by a copper tube 146 which encloses an insulated wire 147. The wire 147 is severed between the thermocouple 140 and the safety control valve mechanism 125 and an interrupter 148 having terminals 149 and 150 is interposed between the severed ends. One of the severed ends of the wire 147 is connected to the terminal 149 and the other severed end is connected to the terminal 150. The purpose and function of the interrupter 148 will be explained in detail in connection with the description of the operation of the apparatus.

The construction of the safety control valve mechanism 125 will now be described, reference being had to Figs. 7, 8 and 9 of the drawings. This mechanism comprises a casing 155 having a chamber 156 in one end thereof and a chamber 157 in the other end thereof, which are connected by a bore 158 of reduced diameter. A valve seat 159 is located at one end of the bore 158 within the chamber 156 which is closed by a removable cap 161. A cylindrical sleeve 163, having end walls 164 and 165, is carried by the cap 161 and extends into the chamber 156. A valve stem 166 which is slidably mounted in a bushing 167 carried by the end wall 165 of the sleeve 163, extends from the chamber 156 into the sleeve 163. A valve disc 168 of suitable material is secured to one end of the valve stem 166 within the chamber 156, and a metal disc 169 is secured to the other end of the valve stem 166 within the sleeve 163. A spring 170 disposed about the valve stem 166 between the valve disc 168 and the end wall 165 of the sleeve 163 normally holds the valve disc 168 against the valve seat 159. An electro-magnet 171 is secured to one end of a hollow exteriorly threaded stud 172 which extends out through aligned apertures in the end wall 164 of the sleeve 163, and in the end of the cap 161. A nut 173 screwed onto the outer portion of the stud 172 securely holds the electro-magnet 171 and the sleeve 163 in place. The legs of the electro-magnet 171 have a winding 174 thereon one end of which is connected to the tube 146 and the other end of which is connected to the wire 147 in the tube 146. The tube 146 is inserted into the hollow stud 172 and is held in place by a screw fitting 148. A sleeve 175 which is carried by the cap 162 as indicated at 176 extends through the chamber 157 and into the bore 158 a short distance. One end of the sleeve 175 is closed by an end wall 177, and the other end

which is open registers with a circular aperture 178 in the end wall of the cap 162. A plug 179 is slidably mounted in the sleeve 175 and extends out through t' e aperture 178 in the cap 162. The outer end of the plug 179 has a reduced extension 180 formed integral therewith, providing an annular shoulder 181 around the extension 180 at the outer end of the plug 179. A stem 182 which is secured to the inner end of the plug 179 extends out through an aperture 183 in the end wall 177 of the sleeve 175 and into the bore 158. A compression spring 187 which is disposed about the stem 182 within the sleeve 175 between the inner face of the end wall 177 and the inner end of the plug 179 is operative to return the plug 179 and stem 182 from the position shown in Fig. 8 back to their normal position as shown in Fig. 7. A port 188 in the casing 155 provides communication between the chamber 156 and the connector 129, and a port 190 establishes communication between the bore 158 and the connector 130. During normal operation gas flows from the main control valve 124 through the connector 129 and port 188 into the chamber 156 and bore 158. From the bore 158 the gas flows through the port 190 and connector 130 into the oven temperature control valve 126 and from there to the main burner 121.

The plug 179 of the safety control valve mechanism is operatively connected to a solenoid 142 by a yoke 192 and a link 193. The yoke 192 which encompasses the safety control valve mechanism 125 as shown in Fig. 9 comprises a pair of spaced parallel arms 194 which are connected together at one end by a bridge 195. The bridge 195 has an aperture 196 therein through which the reduced end 180 of the plug 179 extends with the inner face of the bridge engaging the shoulder 181 between the plug 179 and the reduced extension 180 thereof. The other ends of the arms 194 terminate in a pair of spaced parallel ears 197 to and between which one end of the link 193 is pivotally connected. The other end of the link 193 is pivotally connected to the movable core 198 of the solenoid 142 as indicated at 199.

The solenoid 142 and the interrupter 148 are provided to adapt the apparatus for use in conjunction with a standard time control mechanism 200. When the apparatus is used independently of a time control mechanism the solenoid 142 and the interrupter 148 have no function. When the solenoid 142 is energized it is operative to shift the valve 168 of the safety control mechanism 125 from the closed position as shown in Fig. 7 to the open position as shown in Fig. 8. The energization of the solenoid 142 is controlled by a switch 201 which is adapted to be opened and closed at predetermined set times by the time control mechanism 200. The switch 201 comprises a pair of contacts 202 and 203 which are adapted to be bridged by a conductor bar 204 which is connected to the time control mechanism 200 as indicated at 205. The contact 202 is connected to one side 206 of the line by a lead 207, and the contact 203 is connected to one end of the winding of the solenoid 142 by a lead 208. The other end of the winding of the solenoid 142 is connected to the other side 209 of the line by a lead 210.

The terminal 149 of the interrupter 148 is connected to the contacts 211 and 212 of a double pole switch 213 by a lead 214, and the terminal 150 of the interrupter 148 is connected to the contacts 215 and 216 of the switch 213 by a lead 217. The contacts 211 and 215 and the contacts 212 and 216 are adapted to be alternately bridged by a conductor bar 218 which is shifted from one position to the other at predetermined set times by the time control mechanism through a connection 219.

When this form of the apparatus is used independently of the time control mechanism 200 the switch 213 is in the position shown in Fig. 10 with the conductor bar 218 bridging the contacts 211 and 215. The operation of the main burner 121 is then manually initiated and terminated by the main control valve 124. When the main control valve is turned to the on position gas flows from the manifold M through the main control valve 124, safety control valve mechanism 125 and oven temperature control valve 126 to the main burner 121 where it is ignited by the constantly burning pilot burner 136. After the burner 121 has been ignited the supply of gas thereto is controlled by the oven temperature control valve in accordance with the setting thereof. Should the constantly burning pilot burner 136 become extinguished for any reason while the main burner 121 is ignited, the thermocouple 140 will cool which will de-energize the electro-magnet 171, after which the spring 170 will shift the valve disc 168 into engagement with the valve seat 159 and cut off the flow of gas from the safety control valve mechanism 125 to the main burner 121 through the oven temperature control valve 126. The main burner 121 cannot be ignited again until after the pilot burner 136 has been manually ignited and the safety control valve mechanism manually reset which cannot be done until after the thermocouple has been heated by the pilot burner. The safety control valve mechanism 125 is reset by manually depressing the plug 179 from the position shown in Fig. 7 to the position shown in Fig. 8 which moves the valve disc 168 from the seat 159 and reestablishes communication between the main control valve 124 and the main burner 121. The electro-magnet 171 then holds the valve disc 168 in set position. The electro-magnet 171 as previously stated when energized is strong enough to hold the valve disc 168 in set position against the pressure of the spring 170 as shown in Fig. 8, but it is not strong enough to shift the disc 168 from the position shown in Fig. 7 to the position shown in Fig. 8. It must be shifted by other means.

When the apparatus is used in conjunction with the time control mechanism 200, the time control mechanism is first set to initiate operation at a predetermined time and to terminate operation at a pretermined later time. The setting of the time control mechanism 200 shifts the conductor bar 218 of the switch 213 from engagement with the contacts 211 and 215 and into engagement with the contacts 212 and 216. The shifting of the conductor bar 218 momentarily breaks the electric circuit between the thermocouple 140 and the electro-magnet 171 which de-energizes the electro-magnet 171 and causes it to release the valve disc 168 which is then moved by the spring 170 from the position shown in Fig. 8 to the position shown in Fig. 7, thus closing the exit from the chamber 156 and preventing gas from flowing from the safety control valve mechanism 125 to the main burner 121. When the conductor bar 218 engages the contacts 212 and 216 the circuit between the thermocouple 140 and the electro-magnet 171 is reestablished. The main control valve 124 is then turned on. At the set

time to initiate operation the time control mechanism 200 will momentarily close the switch 201 by moving the conductor bar 204 into and then out of engagement with the contacts 202 and 203. The closing of the switch 201 energizes the solenoid 142 which then resets the safety control valve mechanism, as shown in Fig. 8, to supply gas to the main burner 121 where it is ignited by the constantly burning pilot burner 136. The main burner then operates under the control of the oven temperature control valve until it is extinguished by the time control mechanism. At the set time for terminating operation the time control mechanism 200 moves the conductor bar 218 of the switch 213 out of engagement with the contacts 212 and 216 and back into engagement with the contacts 211 and 215. The shifting of the conductor bar 218 momentarily breaks the electric circuit between the thermocouple 140 and the electro-magnet 171 which de-energizes the electro-magnet 171 and causes the safety control valve mechanism 125 to cut off the supply of gas to and extinguish the main burner 121 as previously described. The main control valve 124 can then be turned off at any time. In the event the constantly burning pilot burner 136 is extinguished for any reason during automatic operation the safety control valve mechanism 125 will function as described in connection with the manual operation of the apparatus.

From the foregoing it will be apparent to those skilled in this art that we have provided a very simple and efficient means for accomplishing the objects of our invention; and it is to be understood that we are not limited to the specific constructions shown and described herein as various modifications may be made thereto within the scope of the appended claims.

What is claimed is:

1. In a burner control apparatus of the character described, the combination of a main burner, a pilot burner by which said main burner is ignited, a conduit through which gaseous fuel is supplied to said main burner, a safety control valve mechanism operative to control the supply of fuel to said main burner interposed in said conduit, a solenoid and operative connecnections between said solenoid and said safety control valve mechanism, a thermocouple disposed adjacent said pilot burner in position to be heated thereby and operative connections between said thermocouple and said safety control valve mechanism, said solenoid being operative when energized to set said safety control valve mechanism in condition to supply fuel to said main burner and said thermocouple being operative when heated to maintain said safety control valve mechanism in said set condition, means operable to control the energization of said solenoid, means operable to render said thermocouple ineffective to maintain said safety control valve mechanism in said set condition, a time control mechanism, operative connections between said time control mechanism and said first mentioned means by which said first mentioned means is actuated at a predetermined time by said time control mechanism to energize said solenoid, and operative connections between said time control mechanism and said second mentioned means by which said second mentioned means is actuated by said time control mechanism at a predetermined later time.

2. In a burner control apparatus of the character described, the combination of a main burner, a pilot burner by which said main burner is ignited, a conduit through which gaseous fuel is supplied to said main burner, a safety control valve mechanism operative to control the supply of fuel to said main burner interposed in said conduit, a solenoid and operative connections between said solenoid and said safety control valve mechanism, an electro-magnet incorporated in said safety control valve mechanism, a thermocouple disposed adjacent said pilot burner in position to be heated thereby and an electric circuit between said thermocouple and said electro-magnet, said solenoid being operative when energized to set said safety control valve mechanism in condition to supply fuel to said main burner, said electro-magnet being operative when energized to maintain said safety control valve mechanism in said set condition and said thermocouple being operative to energize said electro-magnet, means operable to control the energization of said solenoid, means operable to render said thermocouple ineffective to energize said electro-magnet, a time control mechanism, operative connections between said time control mechanism and said first mentioned means by which said first mentioned means is actuated at a predetermined time by said time control mechanism to energize said solenoid, and operative connections between said time control mechanism and said second mentioned means by which said second mentioned means is actuated by said time control mechanism at a predetermined later time.

3. In a burner control apparatus of the character described, the combination of a main burner, a pilot burner by which said main burner is ignited, a conduit through which gaseous fuel is supplied to said main burner, a safety control valve mechanism operative to control the supply of fuel to said main burner interposed in said conduit, a solenoid and operative connections between said solenoid and said safety control valve mechanism, an electro-magnet incorporated in said safety control valve mechanism, said solenoid being operative when energized to set said safety control valve mechanism in condition to supply fuel to said main burner and said electro-magnet being operative when energized to maintain said safety control valve mechanism in said set condition, means operable to control the energization of said solenoid, means operable to control the energization of said electro-magnet, a time control mechanism, operative connections between said time control mechanism and said first mentioned means by which said first mentioned means is actuated at a predetermined time by said time control mechanism to energize said solenoid, and operative connections between said time control mechanism and said second mentioned means by which said second mentioned means is actuated by said time control mechanism at a predetermined later time to effect de-energization of said electro-magnet.

4. In a burner control apparatus of the character described, the combination of a main burner, a pilot burner by which said main burner is ignited, an electric ignition element by which said pilot burner is ignited, a conduit through which gaseous fuel is supplied to said main burner, 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

and said pilot burner, a solenoid and operative connections between said solenoid and said safety control valve mechanism, a thermocouple disposed adjacent said pilot burner in position to be heated thereby, an electric circuit between said thermocouple and said safety control valve mechanism, a normally open valve interposed in said secondary conduit, a second solenoid operative when energized to close said normally open valve, said solenoid being operative upon energization thereof to set said safety control valve mechanism in condition to supply fuel to said main burner and said pilot burner and said thermocouple being operative when heated to maintain said safety control mechanism in said set condition, switching means operative to control the energization of said solenoid and said electric ignition element, a switch operative to control the energization of said second solenoid, a time control mechansm, operative connections between said time control mechanism and said switching means by which said switching means is set by said time control mechanism in condition to energize said solenoid at a predetermined time, and operative connections between said time control mechanism and said switch by which said switch is set by said time control mechanism in condition to energize said second solenoid at a predetermined later time.

5. In a burner control apparatus of the character described, the combination of a main burner, a pilot burner by which said main burner is ignited, an electric ignition element by which said pilot burner is ignited, a conduit through which gaseous fuel is supplied to said main burner, a safety control valve mechanism operative to control the supply of fuel to said main burner interposed in said conduit, a secondary conduit through which fuel is supplied to said pilot burner, a solenoid and operative connections between said solenoid and said safety control valve mechanism, a thermocouple disposed adjacent said pilot burner in position to be heated thereby, said solenoid being operative when energized to set said safety control valve mechanism in condition to supply fuel to said main burner and said thermocouple being operative when heated to maintain said safety control valve mechanism in said set condition, means operable to control the energization of said solenoid, means independent of said safety control valve mechanism operable to extinguish said pilot burner, a time control mechanism, operative connections between said time control mechanism and said first mentioned means by which said first mentioned means is actuated by said time control mechanism to effect energization of said solenoid at a predetermined time, and operative connections between said time control mechanism and said second mentioned means by which said second mentioned means is actuated by said time control mechanism at a predetermined later time.

6. The burner control apparatus as set forth in claim 5 in which said first mentioned means includes a normally open switch and a normally closed switch disposed in series with each other.

7. The burner control apparatus as set forth in claim 6 in which said normally closed switch is operatively connected to a thermostatic element for actuation thereby, said thermostatic element being disposed adjacent said pilot burner in position to be heated thereby.

8. The burner control apparatus as set forth in claim 7 in which said second mentioned means includes a normally open solenoid operated valve interposed in said secondary conduit.

9. The burner control apparatus as set forth in claim 5 in which said second mentioned means includes a solenoid operated valve interposed in said secondary conduit.

10. In a burner control apparatus of the character described, the combination of a main burner, a pilot burner by which said main burner is ignited, an electric ignition element by which said pilot burner is ignited, a conduit through which gaseous fuel is supplied to said main burner, a safety control valve mechanism operative to control the supply of fuel to said main burner interposed in said conduit, a secondary conduit through which fuel is supplied to said pilot burner, a solenoid and operative connections between said solenoid and said safety control valve mechanism, an electro-magnet incorporated in said safety control valve mechanism, a thermocouple disposed adjacent said pilot burner in position to be heated thereby and an electric circuit between said thermocouple and said electro-magnet, said solenoid being operative when energized to set said safety control valve mechanism in condition to supply fuel to said main burner and said electro-magnet being operative when energized to maintain said safety control valve mechanism in said set condition and said thermocouple being operative when heated to energize said electromagnet, means operable to control the energization of said solenoid, means independent of said safety control valve mechanism operable to extinguish said pilot burner, a time control mechanism, operative connections between said time control mechanism and said first mentioned means by which said first mentioned means is actuated by said time control mechanism to effect energization of said solenoid at a predetermined time, and operative connections between said time control mechanism and said second mentioned means by which said second mentioned means is actuated by said time control mechanism at a predetermined later time.

11. In a burner control apparatus of the character described, the combination of a main burner, a constantly burning pilot burner by which said main burner is ignited, a conduit through which gaseous fuel is supplied to said main burner, a safety control valve mechnism operative to control the supply of fuel to said main burner interposed in said conduit, a solenoid and operative connections between said solenoid and said safety control valve mechanism, a thermocouple disposed adjacent said pilot burner in position to be heated thereby, an electric circuit between said thermocouple and said safety control valve mechanism, a switch in said circuit, said solenoid being operative when energized to set said safety control valve mechanism in condition to supply fuel to said main burner and said thermocouple being operative when heated and said switch is closed to maintain said safety control valve mechanism in said set condition, a second switch by which the energization of said solenoid is controlled, a time control mechanism, operative connections between said second switch and said time control mechanism by which said second switch is set by said time control mechanism to energize said solenoid at a predetermined time, and operative connections between said time control mechanism and said switch by which said switch is opened at a predetermined later time by said time control mechanism to

break the circuit between said thermocouple and said safety control valve mechanism.

12. In a burner control apparatus of the character described, the combination of a main burner, a constantly burning pilot burner by which said main burner is ignited, a conduit through which gaseous fuel is supplied to said main burner, a safety control valve mechanism operative to control the supply of fuel to said main burner interposed in said conduit, a solenoid and operative connections between said solenoid and said safety control valve mechanism, an electromagnet incorporated in said safety control valve mechanism, a thermocouple disposed adjacent said pilot burner in position to be heated thereby and an electric circuit between said thermocouple and said electro-magnet, a switch in said circuit, said solenoid being operative when energized to set said safety control valve mechanism in condition to supply fuel to said main burner, said electro-magnet being operative when energized to maintain said safety control valve mechanism in said set condition and said thermocouple being operative when heated to energize said electro-magnet, a second switch by which the energization of said solenoid is controlled, a time control mechanism, operative connections between said second switch

and said time control mechanism by which said second switch is set by said time control mechanism to energize said solenoid at a predetermined time, and operative connections between said time control mechanism and said switch by which said switch is opened at a predetermined later time by said time control mechanism to break the circuit between said thermocouple and said electro-magnet to effect de-energization thereof.

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