Aug. 19, 1952 R. H. JORDAN 2,607,415

OVEN BURNER IGNITION AND CONTROL MECHANISM

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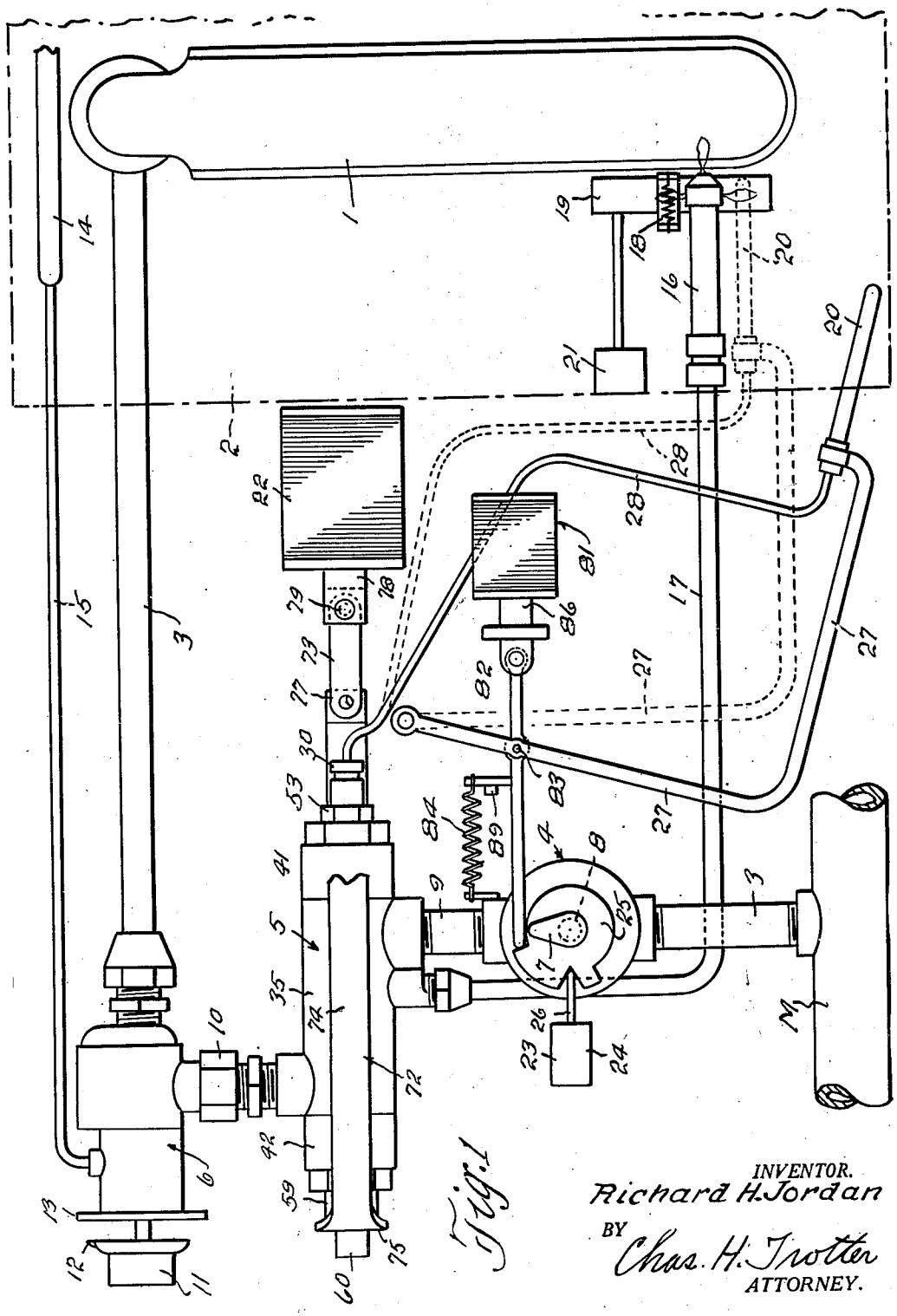


Fig. 1

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Fig. 2

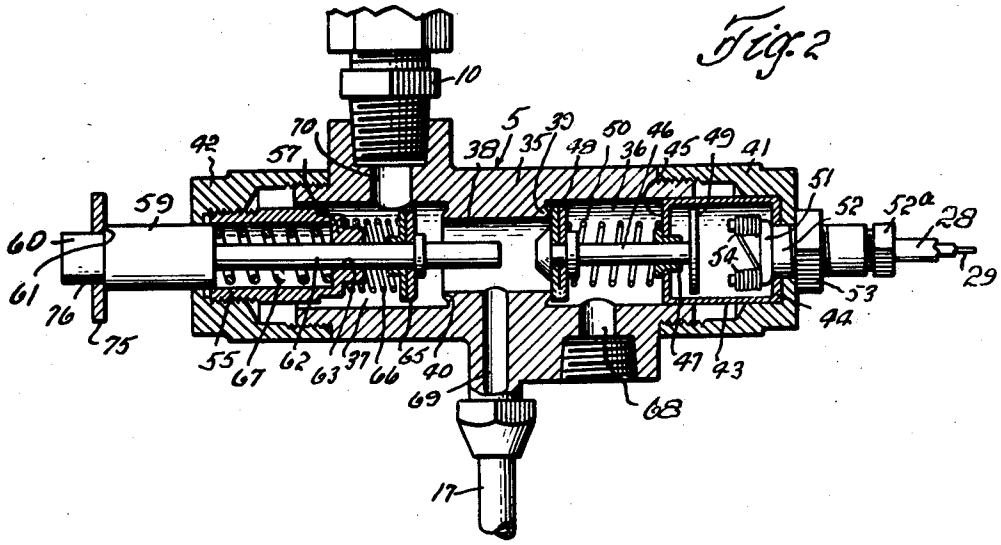
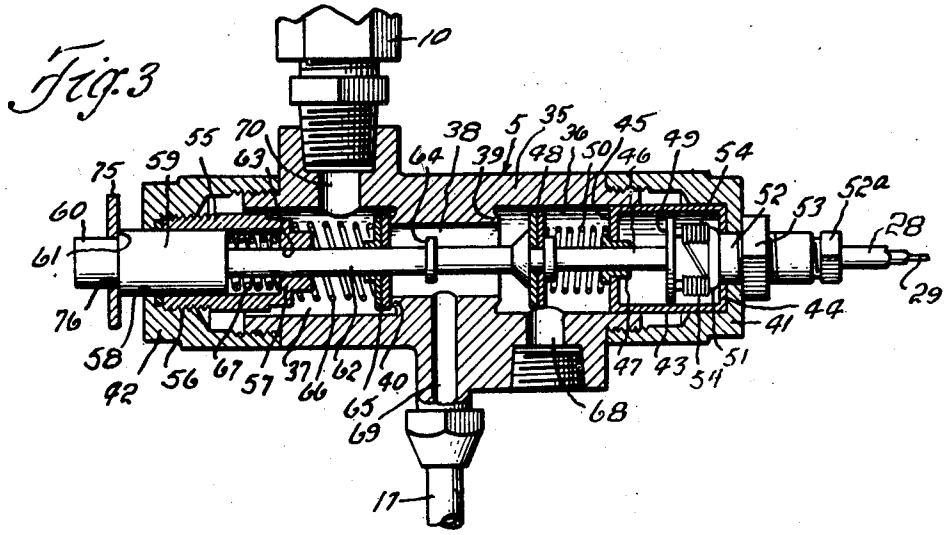


Fig. 3



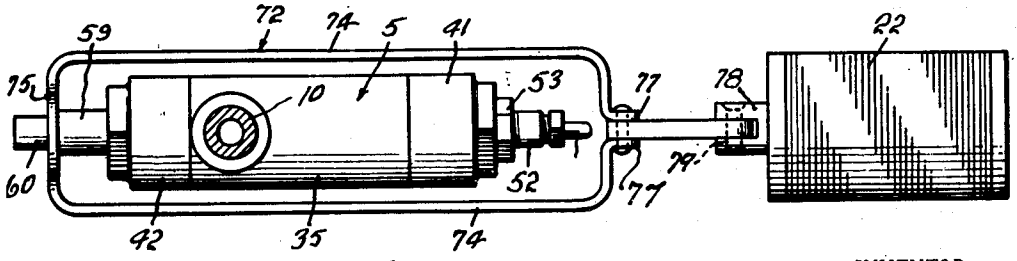


Fig. 4

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OVEN BURNER IGNITION AND CONTROL MECHANISM

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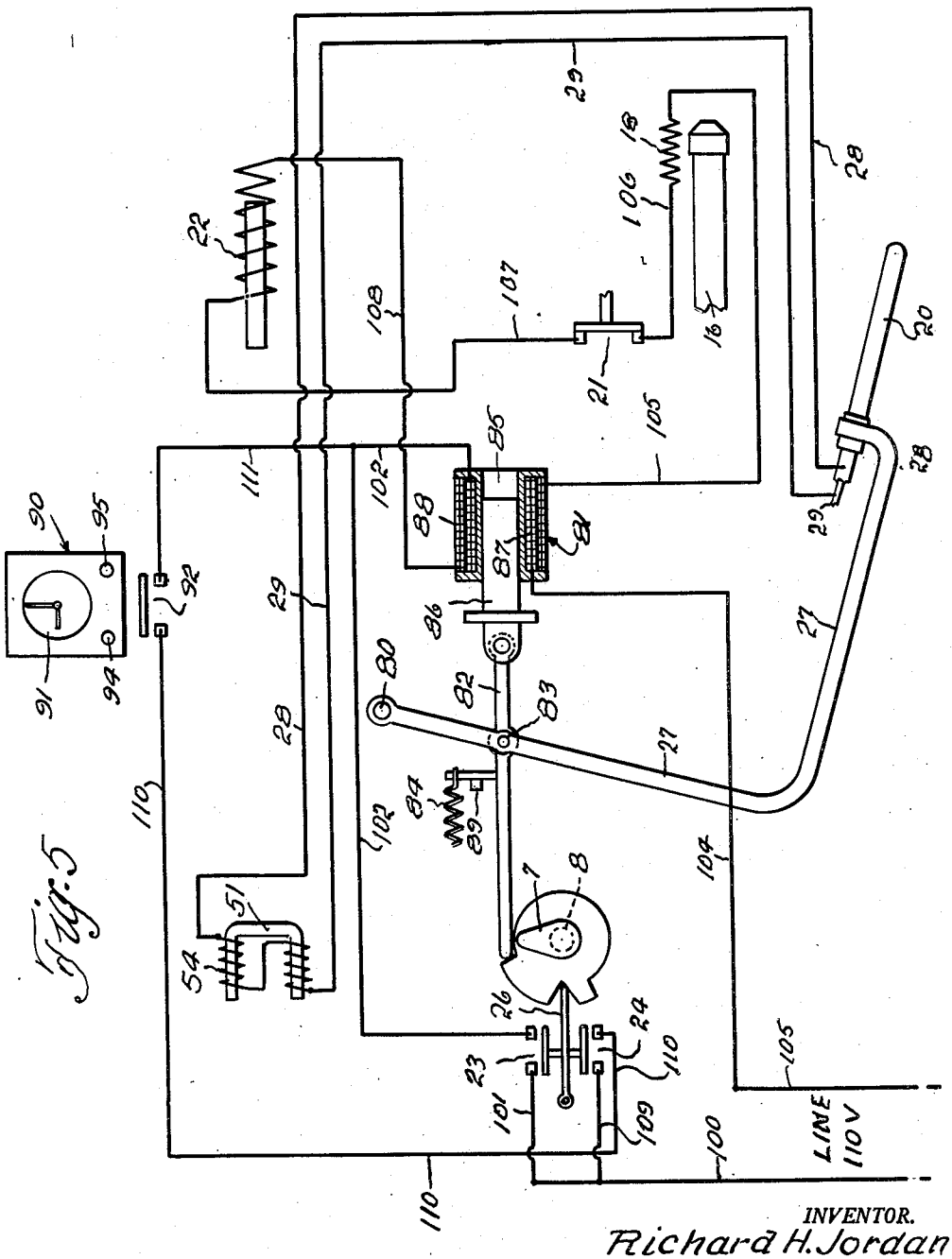


Fig. 5

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OVEN BURNER IGNITION AND CONTROL MECHANISM

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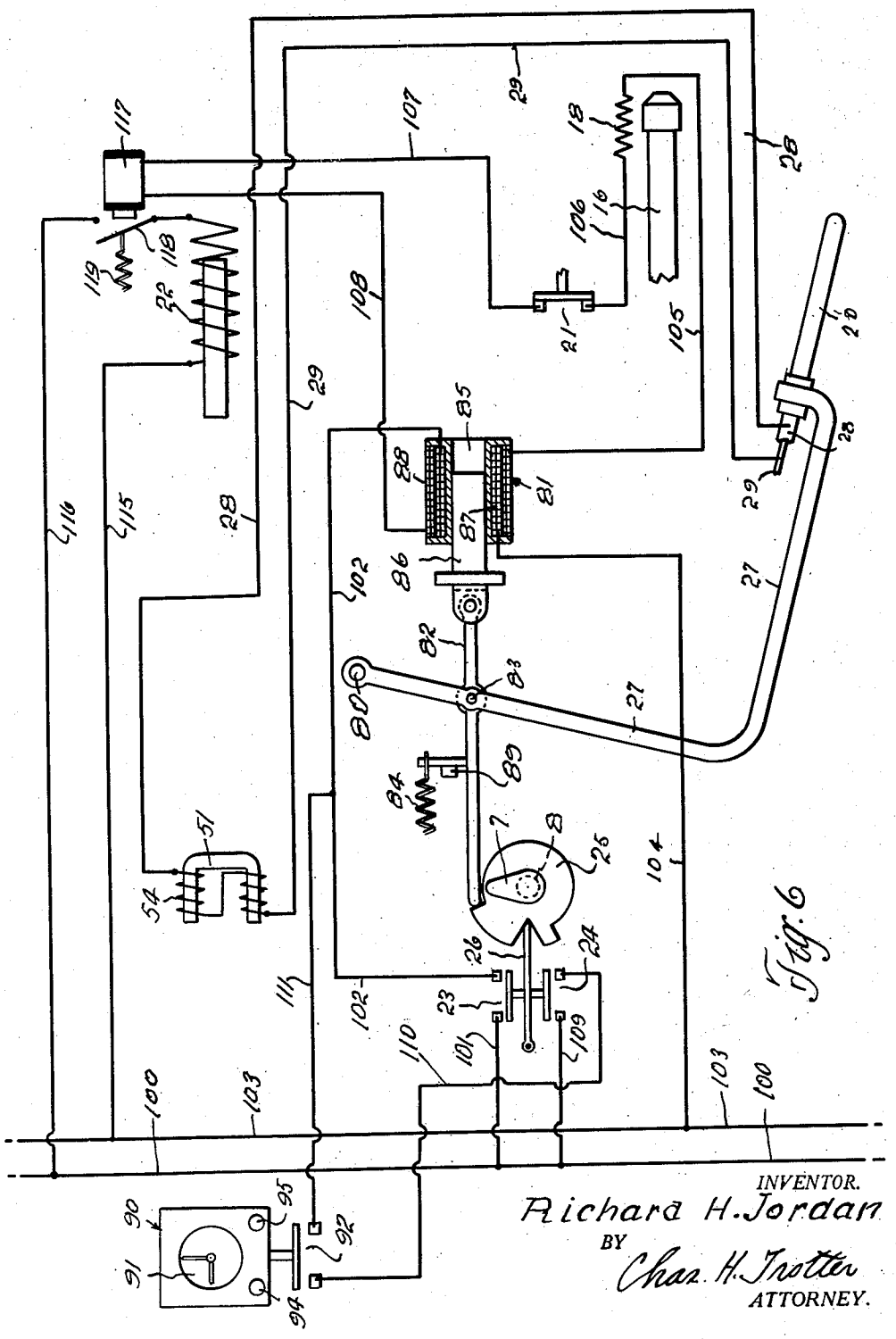


Fig. 6

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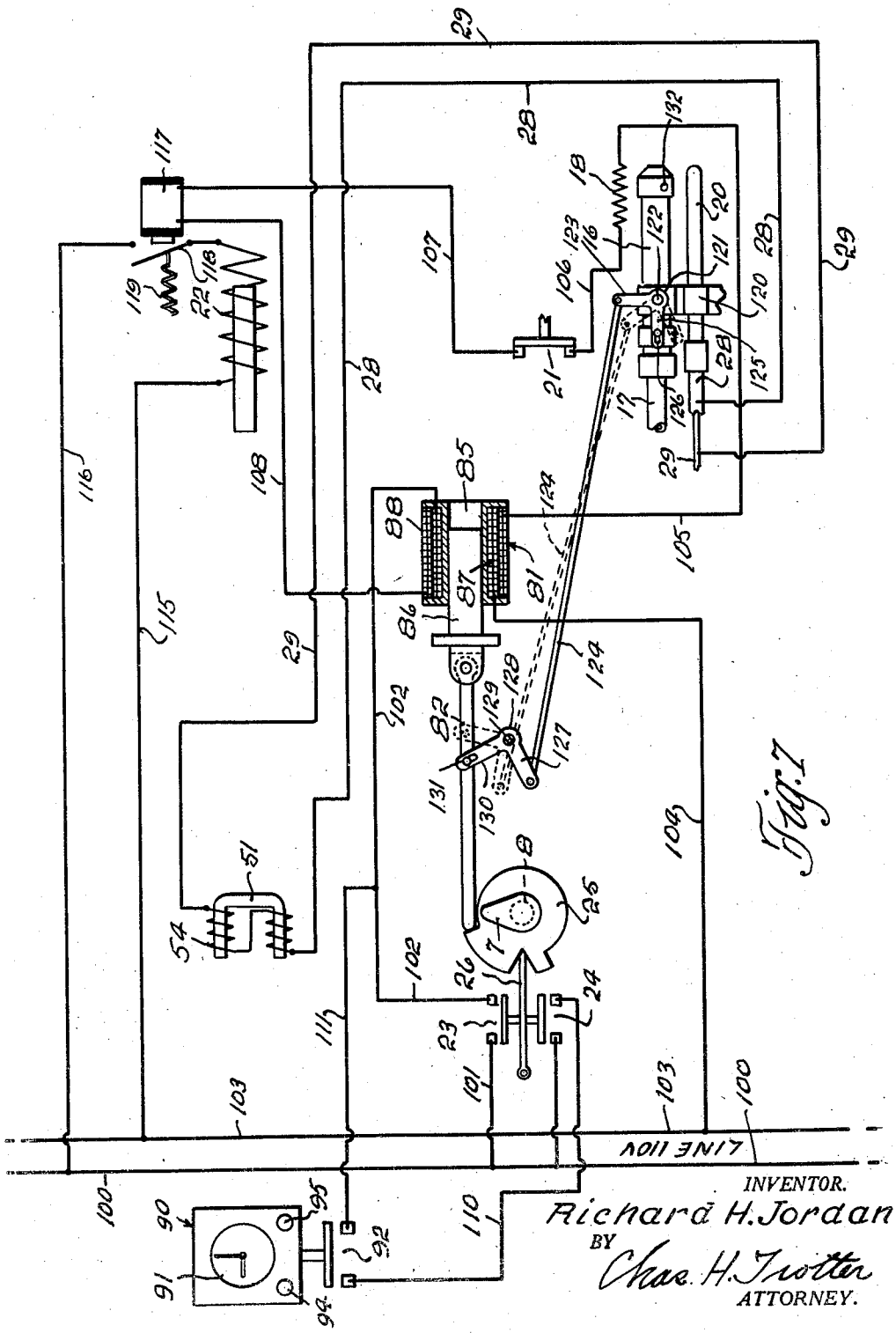


Fig. 7

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UNITED STATES PATENT OFFICE

2,607,415

OVEN BURNER IGNITION AND CONTROL MECHANISM

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Application March 14, 1951, Serial No. 215,439

25 Claims. (Cl. 161—9)

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This invention relates to an automatic ignition and control mechanism for igniting and controlling the operation of cooking range ovens. It is especially adapted for use with a clock actuated time control mechanism which automatically effects the turning on and off of the oven burner at predetermined set times, but is also arranged to be used independently of the time control mechanism in which case the oven burner is manually turned on and off as desired.

The mechanism is designed for use with a main gaseous fuel burner and includes a gaseous fuel pilot burner by which the main burner is ignited. The mechanism is so constructed and arranged that the main burner is under the control of the pilot burner at all times. The pilot burner must be ignited in order for gas to be supplied to the main burner. Should the pilot burner be extinguished for any reason during operation the supply of gas to the main burner will be promptly cut off, and it cannot again be supplied until the pilot burner has been re-ignited. This arrangement provides a safety feature which prevents the accumulation of unburned gas in an oven which may violently explode when an attempt is made to re-ignite either the main or pilot burner. It has been found by experience that both the main burner and the pilot burner in cooking range ovens are frequently extinguished during use for some reason or other without being turned off. This is sometimes due to a momentary gas failure or to the slamming of the oven door or to various other causes.

The mechanism includes in addition to the pilot burner a manually operable main control valve, a safety control valve mechanism, a thermostatically operated oven temperature control valve, a solenoid by which the safety control valve mechanism is initially set in condition to supply gas to the pilot burner, an electric ignition element by which the pilot burner is ignited, a pair of normally open manually operable switches, a normally closed switch which is adapted to be opened by a thermostatic element mounted in position to be heated by the pilot burner, a clock operated switch and electric circuits which include the aforesaid switches, the electric ignition element and the solenoid.

The main control valve is a standard cut-off valve having one closed or off position and two open or on positions. When this valve is turned to one on position the mechanism is set for manual control of the cooking time, and when it is turned to the other on position the cooking time is automatically controlled by the time control mechanism.

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In operation gas flows from the supply manifold through the main control valve and into the safety control mechanism. From the safety control mechanism the gas flows through one conduit to the pilot burner and through another conduit to the oven temperature control valve and from there to the main burner.

The safety control mechanism comprises a casing having a gas inlet port, a pair of gas outlet ports, one to the pilot burner and one to the main burner, a pair of valves and an electromagnet which is energized by a thermocouple which during operation is mounted in position to be heated by the pilot burner. One of the valves is normally closed and is operative in closed position to cut off the flow of gas to both the pilot burner and the main burner; and the other valve is normally open and is operative when in closed position to cut off the flow of gas to the main burner while permitting gas to flow to the pilot burner. The solenoid is operative when energized to close simultaneously the normally open valve and to open the normally closed valve; and the electromagnet is operative when energized to maintain the normally closed valve open after the solenoid has been de-energized. The two normally open switches are operatively associated with the main control valve and are arranged to be closed by the opening of the main control valve and to be opened by the closing of the valve. One of the switches is actuated when the control valve is turned to and from one of its open positions and the other switch is actuated when the control valve is turned to and from the other of its open positions.

To initiate operation of the main burner under manual control of the cooking time, the main control valve is turned to the proper open position which closes the associated normally open switch. The closing of this switch effects the energization of the electric ignition element and the solenoid, and the movement of the thermocouple into position to be heated by the pilot burner. The solenoid then simultaneously closes the normally open valve in the safety control mechanism and opens the normally closed valve. Gas can then flow to the pilot burner but it cannot flow to the main burner. The pilot burner is then ignited by the electric ignition element and projects a flame against and heats both the thermocouple and the thermostatic element. The heating of the thermocouple generates a minute current of the order of .009 to .017 volt

which energizes the electromagnet sufficiently for it to hold the normally closed valve in open position after the solenoid is de-energized, but not enough for the electromagnet to shift the normally closed valve from closed to open position. The heating of the thermostatic element will open the normally closed switch which will break the circuit to and de-energize the electric ignition element and the solenoid. The normally open valve of the safety control mechanism will then return to open position and the electromagnet will hold the normally closed valve open. Gas can then flow to the main burner where it is ignited by the pilot burner. The main burner will then operate under control of the oven temperature control valve as long as the main control valve is open and the pilot burner is ignited and heating the thermocouple and thermostatic element. If the pilot burner is extinguished for any reason during operation, the thermocouple and the thermostatic element will immediately cool. The cooling of the thermocouple will de-energize the electromagnet which will release the normally closed valve which will then return to its closed position and cut off the flow of gas to both the pilot burner and the main burner. The cooling of the thermostatic element will close the normally closed switch which will then effect re-energization of the solenoid and the electric ignition element. The solenoid will then open the normally closed valve and close the normally open valve, thus supplying gas to the pilot burner only. If the pilot burner is then re-ignited it will re-heat the thermostatic element and the thermocouple, thus re-initiating operation after which the mechanism will operate as described. To terminate operation the main control valve is manually closed.

For automatic operation I provide a clock actuated time control mechanism which may be set to initiate operation of the main burner at a predetermined set time and to terminate operation thereof at a predetermined set later time. The time control mechanism includes a normally open switch which is in series with one of the normally open switches associated with the main control valve. For automatic operation the time control is set to initiate operation at the desired time and to terminate operation at the desired later time and then the main control valve is turned to the proper open or on position which closes the normally open switch associated therewith. At the set time the time control mechanism will automatically close its normally open switch which will effect energization of the solenoid and the electric ignition element after which the mechanism will function exactly the same as with manual control until time to terminate operation, at which time the time control mechanism will automatically open the associated normally open switch which will, as is hereinafter described, effect the cooling of the thermocouple which will de-energize the electromagnet. The electromagnet then releases the normally closed switch of the safety control mechanism which returns to its closed position and cuts off the flow of gas to both the pilot burner and the main burner, thus terminating operation.

The various component parts of the mechanism are so constructed and arranged that gas cannot be supplied to either the main burner or the pilot burner in the event the electric ignition element has been broken or burned out.

Means are also provided by which the oven burner can be manually ignited and controlled in the event of power failure.

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 a device of the character described improved means for initiating and terminating operation of an oven burner which includes a thermocouple which is adapted to be moved into and out of position to be heated by a pilot burner by which the oven burner is ignited.

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

Fig. 1 is a diagrammatic layout illustrating my improved automatic ignition and control mechanism applied to a cooking range oven burner using gaseous fuel;

Fig. 2 is an enlarged central longitudinal vertical section through the safety control mechanism showing the various parts in the positions 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 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 mechanism;

Fig. 6 is a view similar to Fig. 5 showing a slightly modified form of the invention, and

Fig. 7 is a view similar to Fig. 6 showing still another form of the invention.

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 M through a conduit 3. Interposed in the conduit 3 are a main control valve 4, a safety control 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 having one closed or off position and two open or on positions. In either of the open positions it permits the flow of gas from the manifold M to the burner 1, and in the closed position it completely cuts off the flow of gas from the manifold M. In one open position of the main control valve 4 the mechanism is set for manual control and in the other open position the mechanism is set for automatic control. 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 either of the on positions, and prevents 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 mechanism 5, to be described in detail hereinafter. From the safety control 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 constructions. 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 mechanism and the pilot burner 16. The pilot burner 16 is disposed adjacent one 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 is 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 mechanism to supply gas to the pilot burner 16, as will be described in connection with the description of the safety control mechanism and the operation of the whole apparatus. A thermocouple 20 which is carried by a pivoted arm 27 is adapted to be moved into and out of position to be heated by the pilot burner 16, as shown by the full line and dotted line portions in Fig. 1. The thermocouple 20 when heated is operative to hold the safety control 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 mechanism and the operation of the apparatus.

A pair of normally open master switches 23 and 24 are operatively associated with the valve stem 8 of the main control valve 4 and are adapted to be closed and opened by the opening and closing of the valve 4. As the valve stem 8 is turned in a clockwise direction to set the valve in one open position, the switch 23 is closed by a cam 25 on the valve stem 8 through a link 26; and when the valve stem 8 is rotated in a counterclockwise direction to set the valve 4 in its other open position, the switch 24 is closed by the cam 25 through the link 26. Conversely when the valve 4 is turned from either open position to the closed position the closed switch 23 or 24 will be opened.

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 discs 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 electromagnet 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 secured onto the outer portion of the stud 52 securely holds the magnet 51 and the sleeve 43 in place. The legs of the electromagnet 51 have a winding 54 thereon, one end of which is connected to a copper tube 28 which extends between the thermocouple 20 and the safety control 5, and the other end of which is connected to an insulated wire 29 within the tube 28. The tube 28 and the wire 29 therein establish an electric circuit between the thermocouple 20 and the winding 54 of the electromagnet 51. The tube 28 is inserted into the hollow stud 52 and is held in place by a screw fitting 30. 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 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 arm 27 carrying the thermocouple 20 is pivotally secured, as indicated at 80, and is adapted to be moved from the full line position shown in Fig. 1 to the dotted line position therein by a solenoid-transformer 81 and a link 82 which is pivotally secured to the arm 27 at 83. A spring 84 which is connected to the link 82 biases the arm 27 and thermocouple 20 to the full line position. A stop 85 is provided to limit the movement of the arm 27 by the spring 84.

The solenoid-transformer 81 comprises a stationary core 85, a movable core 86, a primary winding 87 and a secondary winding 88.

In order to accommodate the mechanism for automatic control, I provide a clock operated time control mechanism 90 of standard construction which comprises a clock 91 and a normally open switch 92 which is adapted to be automatically closed and opened at predetermined times according to the setting of the clock 91, which may be set as desired by the buttons 94 and 95. The switch 92 is disposed in series with the switch 24 and is operative when closed to initiate and maintain operation of the main burner 1.

The operation of the apparatus independently of the time control mechanism will now be described 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 turn manually the main control valve 4 clockwise from the off position to one 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 link 26. 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 further 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 the positive side 100 of the line through the lead 101 to the switch 23. From the switch 23 the current flows through the lead 102 to one side of the primary winding 87, of the solenoid-transformer 81, and from the other side of the primary winding 87 back to the other side 103 of the line through the lead 104. The electric resistance ignition element 18, the normally closed switch 21 and the solenoid 22 are all connected in series with the secondary winding 88 of the solenoid-transformer 81 by the leads 105, 106, 107 and 108. The closing of the switch 23 thus energizes the solenoid-transformer 81 which through the movable core 86 thereof and the link

82 moves the arm 27 and thermocouple 20 from the full line position to the dotted line position (Fig. 1), thus bringing the thermocouple 20 into position to be heated by the pilot burner 16. The solenoid-transformer 81 when energized also through the secondary winding and circuit 105 to 108 energizes the electric resistance ignition element 18 and the solenoid 22. The secondary current generated by the solenoid-transformer 81 is of much lower voltage than the line current. The electric ignition element 18 and the solenoid 22 are now both energized. The energizing of the ignition element 18 renders it operable to ignite the pilot burner 16 as soon as gas is supplied thereto, and the energization of the solenoid 22 causes it, through the link 73 and yoke 72, to shift the various parts of the safety control mechanism 5 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 of the order of .009 to .017 volt which energizes the electromagnet 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 28 and the wire 29. 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 a conduit 3 to the main burner 1 where it will be ignited by the pilot burner 16. The apparatus is now operating nor-

mally, and in the absence of any abnormal condition 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, provided the ignition element 18 is intact, 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.

If, however, the ignition element 18 has been broken or burned out or otherwise affected so that current cannot pass therethrough, the solenoid 22 cannot be re-energized since it is in series with the ignition element 18. Consequently the valve 48 will remain closed, as shown in Fig. 2, cutting off the supply of gas to both the main burner and the pilot burner. 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, I extend the link 82 so that it can be engaged and shifted by the cam 25 to move the arm 27 and thermocouple 20 from the full line to the dotted line position as the main control valve 4 is opened by a clockwise movement of the valve stem 3. Thus in the event power is not available, the main burner 1 can be operated by opening the main control valve 4 in a clockwise direction and then holding a match to the pilot burner 16 and manually moving the plunger 59 from the position shown in Fig. 2 to the position shown in Fig. 3 and holding 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 apparatus is used in conjunction with the time control mechanism 90, 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. After the time control mechanism has been set, the main control valve 4 is manually opened in a counterclockwise direction which closes the master switch 24. Then at the predetermined set time the time control mechanism will close the switch 92. Current will then flow from the positive side 100 of the line through the lead 109 to the switch 24. From the switch 24 the current will flow through the lead 110 to the switch 92 and from the switch 92 to the primary winding 87 of the solenoid-transformer 81 through the leads 111 and 102. From the winding 87 the current will flow back to the negative side 103 of the line through the lead 104, thus completing the circuit to and energizing the solenoid-transformer. The solenoid-transformer will then move the thermocouple 20 into position to be heated by the pilot burner and energize the ignition element 18 and solenoid 22 which will initiate operation, as previously described. The main burner 1 will then operate under the control of the pilot burner 16 and oven temperature control valve 6, as previously described, until its operation is terminated by the opening of the switch 92 by the clock 91. The opening of the switch 92 will break the circuit to the solenoid-transformer 81 which will allow the spring 84 to shift the arm 27 and thermocouple 20 from the dotted line position back to the full line position in which position the thermocouple will immediately cool. The cooling of the thermocouple 20 will de-energize the electromagnet 51 which will then release the valve 48, which, when released, will return to closed position and cut off the supply of gas to both the main burner and the pilot burner, thus terminating operation. The main control can then be manually closed any time later.

In Fig. 6 I have shown a slightly modified form of the invention. In this form of the invention I connect the solenoid 22 directly to the line 100—103 by the leads 115 and 116, and I interpose a relay 117 in the secondary circuit 105 to 108 in place of the solenoid 22. In the lead 116 between the line 100—103 and the solenoid 22, I interpose a normally open switch 118 which is biased to open position by a spring 119. The relay 117 is disposed in operative relation to the switch 118 and is operative when energized to maintain the switch 118 in closed position. Otherwise the construction and operation of this form of the invention is identical with the form shown in Figs. 1 to 5 and the same reference characters are applied to like parts.

In the form of the invention when the switch 23 or the switches 24 and 92 are closed the solenoid transformer 81 will move the thermocouple 20 into heat exchange relationship with the pilot burner 16, and will effect the energization of the electric ignition element 18 and the relay 117. The relay 117 will then close the switch 118, thereby energizing the solenoid 22 which will actuate the safety control valve mechanism 5 to supply gas to the pilot burner 16 where it is ignited by the electric ignition element 18. The pilot burner will then heat both the thermostatic element 19 and the thermocouple 20. The heating of the thermocouple 20 will energize the electromagnet 51 and render it operative to maintain the valve 48 of the safety control valve mechanism 5 open after the solenoid 22 has been de-energized, and the heating of the thermostatic element 19 will cause it to open the normally closed switch 21 in the secondary circuit which will de-energize the electric ignition element 18 and the relay 117. The spring 119 will then open the switch 118 and de-energize the solenoid 22 after which the apparatus will operate as previously described in connection with Figs. 1 to 5.

In Fig. 7 I have shown still another form of the invention. In this form of the invention I move

the pilot burner 16 into and out of heat exchanging relationship with respect to the thermocouple 20 instead of moving the thermocouple 20 into and out of heat exchanging relationship with respect to the pilot burner 16. As shown in Fig. 7, I mount the pilot burner 16 and the thermocouple 20 side by side in a fixed bracket 120, the pilot burner 16 being mounted for rotary movement therein but restrained from linear movement. A bell crank 121 which is pivotally secured at 122 to the bracket 120 has one arm 123 thereof pivotally connected to one end of a link 124 and the other arm 125 thereof connected to the pilot burner 16 by a pin and slot connection 126. The other end of the link 124 is pivotally connected to one arm 127 of a bell crank 128 which is rotatably mounted upon a fixed stud 129. The other arm 130 of the bell crank 128 is connected to the link 82 by a pin and slot connection as indicated at 131.

In this form of the invention when the switch 23 or the switches 24 and 92 are closed the solenoid-transformer 81 will move the bell cranks 128 and 121 from the full line positions to the dotted line positions which will rotate the pilot burner 16 in the bracket 120 and bring the jet 132 of the pilot burner 16 into position to project a flame against and heat the thermocouple 20. The closing of the switch 23 or the switches 24 and 92 will also effect energization of the electric ignition element 18 and the relay 117, after which the apparatus will operate as described in connection with Fig. 6.

If desired, in this form of the invention the relay 117 may be eliminated and the solenoid 22 placed in the secondary circuit as shown in Fig. 5.

From the foregoing it will be apparent to those skilled in this art that I have provided a very simple and efficient apparatus for accomplishing the objects of the invention.

It is to be understood that I am 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, an electric ignition element operative 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 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 after said main control valve has been opened, a solenoid by 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 moved into and out of position 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, a solenoid-transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said solenoid-transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element, said solenoid and said secondary winding are disposed in series with each other, said solenoid-transformer being operative when energized to move said thermocouple into position to be heated by said pilot burner and to energize said electric ignition element and said solenoid, and means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element.

2. In an automotive 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 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 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 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 maintain said normally closed valve open after it has been open 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 said pilot burner and said main burner, a thermocouple adapted to be moved into and out of position 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, a solenoid-transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said solenoid-transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element, said solenoid and said secondary winding are disposed in series with each other, said solenoid-transformer being operative when energized to move said thermocouple into position to be heated by said pilot burner and to energize said electric ignition element and said solenoid, and means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element.

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 ele-

ment operative 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 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 after said main control valve has been opened, a solenoid by 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 moved into and out of position to be heated by said pilot burner, means rendered operative by the opening of said main control valve to move said thermocouple into position to be heated by said pilot burner, a transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element, said solenoid and said secondary winding are disposed in series with each other, said transformer being operative when energized to energize said electric ignition element and said solenoid, and means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element.

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, an electric ignition element operative 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 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 after said main control valve has been opened, a solenoid by 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 moved into and out of position 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, a solenoid-transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said solenoid-transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element, said solenoid and said secondary winding are disposed in series with each other, said solenoid-transformer being operative when energized to move said thermocouple into position to be heated by said pilot burner and to energize said electric ignition element and said solenoid, and means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element, said means comprising a normally closed switch in said secondary circuit and a thermostatic element adapted to be heated by said pilot burner and operative when heated to open said normally closed switch.

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 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 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 after said main control valve has been opened, a solenoid by 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 moved into and out of position to be heated by said pilot burner, means rendered operative by the opening of said main control valve to move said thermocouple into position to be heated by said pilot burner, a transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element, said solenoid and said secondary winding are disposed in series with each other, said solenoid-transformer being operative when energized to move said thermocouple into position to be heated by said pilot burner and to energize said electric ignition element and said solenoid, and means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element, said means comprising a normally closed switch in said secondary circuit and a thermostatic element adapted to be heated by said pilot burner and operative when heated to open said normally closed switch.

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, an electric ignition element operative 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 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 after said main control valve has been opened, a solenoid by 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 moved into and out of position 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, a solenoid-transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said solenoid-transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element said solenoid and said secondary winding are disposed in series with each other, said solenoid-transformer being operative when energized to move said thermocouple into position to be heated by said pilot burner and to energize said electric ignition element and said solenoid, means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element, and clock actuated time control mechanism operative to close and open said master switch at predetermined set times.

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 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 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 after said main control valve has been opened, a solenoid by 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 moved into and out of position to be heated by said pilot burner, means rendered operative by the opening of said main control valve to move said thermocouple into position to be heated by said pilot burner, a transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element said solenoid and said secondary winding are disposed in series with each other, said transformer being operative when energized to energize said electric ignition element and said solenoid, means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element, and clock actuated time control mechanism operative to close and open said master switch at predetermined set times.

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, an electric ignition element operative 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 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 after said main control valve has been opened, a solenoid by 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 moved into and out of position 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, a solenoid-transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said solenoid-transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element said solenoid and said secondary winding are disposed in series with each other, said solenoid-transformer being operative when energized to move said thermocouple into position to be heated by said pilot burner and to energize said electric ignition element and said solenoid, means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element, and clock actuated time control mechanism operative to close and open said master switch at predetermined set times, said means comprising a normally closed switch in said secondary circuit and a thermostatic element adapted to be heated by said pilot burner and operative when heated to open said normally closed switch.

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, an electric ignition element operative 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 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 after said main control valve has been opened, a solenoid by 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 moved into and out of position to be heated by said pilot burner, means rendered operative by the opening of said main control valve to move said thermocouple into position to be heated by said pilot burner, a transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element said solenoid and said secondary winding are disposed in series with each other, said transformer being operative when energized to energize said electric ignition element and said solenoid, means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element, and clock actuated time control mechanism operative to close and open said master switch at predetermined set times, said means comprising a normally closed switch in said secondary circuit and a thermostatic element adapted to be heated by said pilot burner and operative when heated to open said normally closed switch.

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, an electric ignition element operative 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 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 after said main control valve has been opened, a solenoid by 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 moved into and out of position to be heated by said pilot burner, a cam associated with said main control valve and operative to move said thermocouple into position to be heated by said pilot burner simultaneously with the opening of said main control valve, a transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element said solenoid and said secondary winding are disposed in series with each other, said transformer being operative when energized to energize said electric ignition element and said solenoid, and means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element.

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 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 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 after said main control valve has been opened, a solenoid by 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 moved into and out of position to be heated by said pilot burner, a cam associated with said main control valve and operative to move said thermocouple into position to be heated by said pilot burner simultaneously with the opening of said main control valve, a transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element said solenoid and said secondary winding are disposed in series with each other, said transformer being operative when energized to energize said electric ignition element and said solenoid, means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element, and clock actuated time control mechanism operative to close and open said master switch at predetermined set times.

12. 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 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 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 after said main control valve has been opened, a solenoid by 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 moved into and out of position to be heated by said pilot

burner, a cam associated with said main control valve and operative to move said thermocouple into position to be heated by said pilot burner simultaneously with the opening of said main control valve, a transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element said solenoid and said secondary winding are disposed in series with each other, said transformer being operative when energized to energize said electric ignition element and said solenoid, means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element, and clock actuated time control mechanism operative to close and open said master switch at predetermined set times, said means comprising a normally closed switch in said secondary circuit and a thermostatic element adapted to be heated by said pilot burner and operative when heated to open said normally closed switch.

13. 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 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 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 after said main control valve has been opened, a solenoid by 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, means by which said pilot burner and said thermocouple are mounted for relative movement into and out of heat exchanging relationship with respect to each other, an electric circuit between said thermocouple and said electromagnet through which said electromagnet is energized by said thermocouple when heated, a solenoid-transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said solenoid-transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element, said solenoid and said secondary winding are disposed in series with each other, said solenoid-transformer being operative when energized to effect heat exchanging relationship between said thermocouple and said pilot burner and to energize said electric ignition element and said solenoid, and means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element.

14. 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 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 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 after said main control valve has been opened, a solenoid by 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 operative when heated to energize said electromagnet, means by which said thermocouple and said pilot burner are mounted for relative movement into and out of heat exchanging relationship with respect to each other, means rendered operative by the opening of said main control valve to effect heat exchanging relationship between said pilot burner and said thermocouple, a transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element said solenoid and said secondary winding are disposed in series with each other, said transformer being operative when energized to energize said electric ignition element and said solenoid, and means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element.

15. 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 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 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 after said main control valve has been opened, a solenoid by 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 operative when heated to energize said electromagnet, means by which said thermocouple and said pilot burner are mounted for relative movement into and out of heat exchanging relationship with respect to each other, a cam associated with said main control valve and

operative upon the opening of said main control valve to effect simultaneously heat exchanging relationship between said pilot burner and said thermocouple, a transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element said solenoid and said secondary winding are disposed in series with each other, said transformer being operative when energized to energize said electric ignition element and said solenoid, and means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element.

16. 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 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 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 after said main control valve has been opened, a solenoid by 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, means by which said pilot burner and said thermocouple are mounted for relative movement into and out of heat exchanging relationship with respect to each other, an electric circuit between said thermocouple and said electromagnet through which said electromagnet is energized by said thermocouple when heated, a solenoid-transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said solenoid-transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element said solenoid and said secondary winding are disposed in series with each other, said solenoid-transformer being operative when energized to effect heat exchanging relationship between said thermocouple and said pilot burner and to energize said electric ignition element and said solenoid, means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element, and clock actuated time control mechanism operative to close and open said master switch at predetermined set times.

17. 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 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 is primarily controlled, a safety control valve mechansm 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 after said main control valve has been opened, a solenoid by 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 operative when heated to energize said electromagnet, means by which said thermocouple and said pilot burner are mounted for relative movement into and out of heat exchanging relationship with respect to each other, means rendered operative by the opening of said main control valve to effect heat exchanging relationship between said pilot burner and said thermocouple, a transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element said solenoid and said secondary winding are disposed in series with each other, said transformer being operative when energized to energize said electric ignition element and said solenoid, and means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element, and clock actuated time control mechanism operative to close and open said master switch at predetermined set times.

18. 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 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 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 after said main control valve has been opened, a solenoid by 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 operative when heated to energize said electromagnet, means by which said thermocouple and said pilot burner are mounted for relative movement into and out of heat exchanging relationship with respect to each other, a cam associated with said main control valve and operative upon the opening of said main control valve to simultaneously effect heat exchanging relationship between said pilot burner and said ther-

mocouple, a transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element, said solenoid and said secondary winding are disposed in series with each other, said transformer being operative when energized to energize said electric ignition element and said solenoid, means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element, and clock actuated time control mechanism operative to close and open said master switch at predetermined set times.

19. 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 to ignite said pilot burner, a conduit thorugh 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 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 after said main control valve has been opened, a solenoid by 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, means by which said pilot burner and said thermocouple are mounted for relative movement into and out of heat exchanging relationship with respect to each other, an electric circuit between said thermocouple and said electromagnet through which said electromagnet is energized by said thermocouple when heated, a solenoid-transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said solenoid-transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element, said solenoid and said secondary winding are disposed in series with each other, said solenoid-transformer being operative when energized to effect heat exchanging relationship between said thermocouple and said pilot burner and to energize said electric ignition element and said solenoid, means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element, and clock actuated time control mechanism operative to close and open said master switch at predetermined set times, said means comprising a normally closed switch in said secondary circuit and a thermostatic element adapted to be heated by said pilot burner and operative when heated to open said normally closed switch.

20. 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 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 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 after said main control valve has been opened, a solenoid by 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 operative when heated to energize said electromagnet, means by which said thermocouple and said pilot burner are mounted for relative movement into and out of heat exchanging relationship with respect to each other, means rendered operative by the opening of said main control valve to effect heat exchanging relationship between said pilot burner and said thermocouple, a transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element said solenoid and said secondary winding are disposed in series with each other, said transformer being operative when energized to energize said electric ignition element and said solenoid, means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element, and clock actuated time control mechanism operative to close and open said master switch at predetermined set times, said means comprising a normally closed switch in said secondary circuit and a thermostatic element adapted to be heated by said pilot burner and operative when heated to open said normally closed switch.

21. 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 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 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 after said main control valve has been opened, a solenoid by 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 operative when heated to energize said electromagnet, means by which

said thermocouple and said pilot burner are mounted for relative movement into and out of heat exchanging relationship with respect to each other, a cam associated with said main control valve and operative upon the opening of said main control valve to simultaneously effect heat exchanging relationship between said pilot burner and said thermocouple, a transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element said solenoid and said secondary winding are disposed in series with each other, said transformer being operative when energized to energize said electric ignition element and said solenoid, means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element, and clock actuated time control mechanism operative to close and open said master switch at predetermined set times, said means comprising a normally closed switch in said secondary circuit and a thermostatic element adapted to be heated by said pilot burner and operative when heated to open said normally closed switch.

22. 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 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 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 after said main control valve has been opened, a solenoid by 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 operative when heated to energize said electromagnet, means by which said pilot burner is mounted for movement into and out of heat exchanging relationship with said thermocouple, a solenoid-transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said solenoid-transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element said solenoid and said secondary winding are disposed in series with each other, said solenoid-transformer being operative when energized to move said pilot burner into position to heat said thermocouple and to energize said electric ignition element and said solenoid, and means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element.

23. 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 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 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 after said main control valve has been opened, a solenoid by 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 operative when heated to energize said electromagnet, means by which said pilot burner is mounted for movement into and out of heat exchanging relationship with said thermocouple, means rendered operative by the opening of said main control valve to move said pilot burner into position to heat said thermocouple, a transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element said solenoid and said secondary winding are disposed in series with each other, said transformer being operative when energized to energize said electric ignition element and said solenoid, and means operative to break said secondary circuit and de-energize said electric ignition element and said solenoid after said pilot burner has been ignited by said electric ignition element.

24. 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 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 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 after said main control valve has been opened, a solenoid by which said safety control valve mechanism is set in condition to supply fuel to said pilot burner and said main burner, a solenoid switch operative when closed to effect energization of said solenoid, a relay operative when energized to close said solenoid switch, 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 operative when heated to energize said electromagnet, means by which said pilot burner is mounted for movement into and out

of heat exchanging relationship with said thermocouple, a solenoid-transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said solenoid-transformer, a primary circuit which includes said primary winding and said master switch, a secondary circuit in which said electric ignition element said relay and said secondary winding are disposed in series with each other, said solenoid-transformer being operative when energized to move said pilot burner into position to heat said thermocouple and to energize said electric ignition element and said relay, and means operative to break said secondary circuit and thereby effect de-energization of said electric ignition element said relay and said solenoid after said pilot burner has been ignited by said electric ignition element.

25. 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 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 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 after said main control valve has been opened, a solenoid by which said safety control valve mechanism is set in condition to supply fuel to said pilot burner and said main burner, a solenoid switch operative when closed to effect energization of said solenoid, a relay operative when energized to close said solenoid switch, 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 operative when heated to energize said electromagnet, means by which said pilot burner is mounted for movement into and out of heat exchanging relationship with said thermocouple, means rendered operative by the opening of said main control valve to move said pilot burner into position to heat said thermocouple, a transformer having a primary winding and a secondary winding, a master switch operative when closed to effect energization of said transformer, a primary circuit which includes said master switch and said primary winding, a secondary circuit in which said electric ignition element said relay and said secondary winding are disposed in series with each other, said transformer being operative when energized to energize said electric ignition element and said relay, and means operative to break said secondary circuit and thereby effect de-energization of said electric ignition element said relay and said solenoid after said pilot burner has been ignited by said electric ignition element.

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No references cited.