

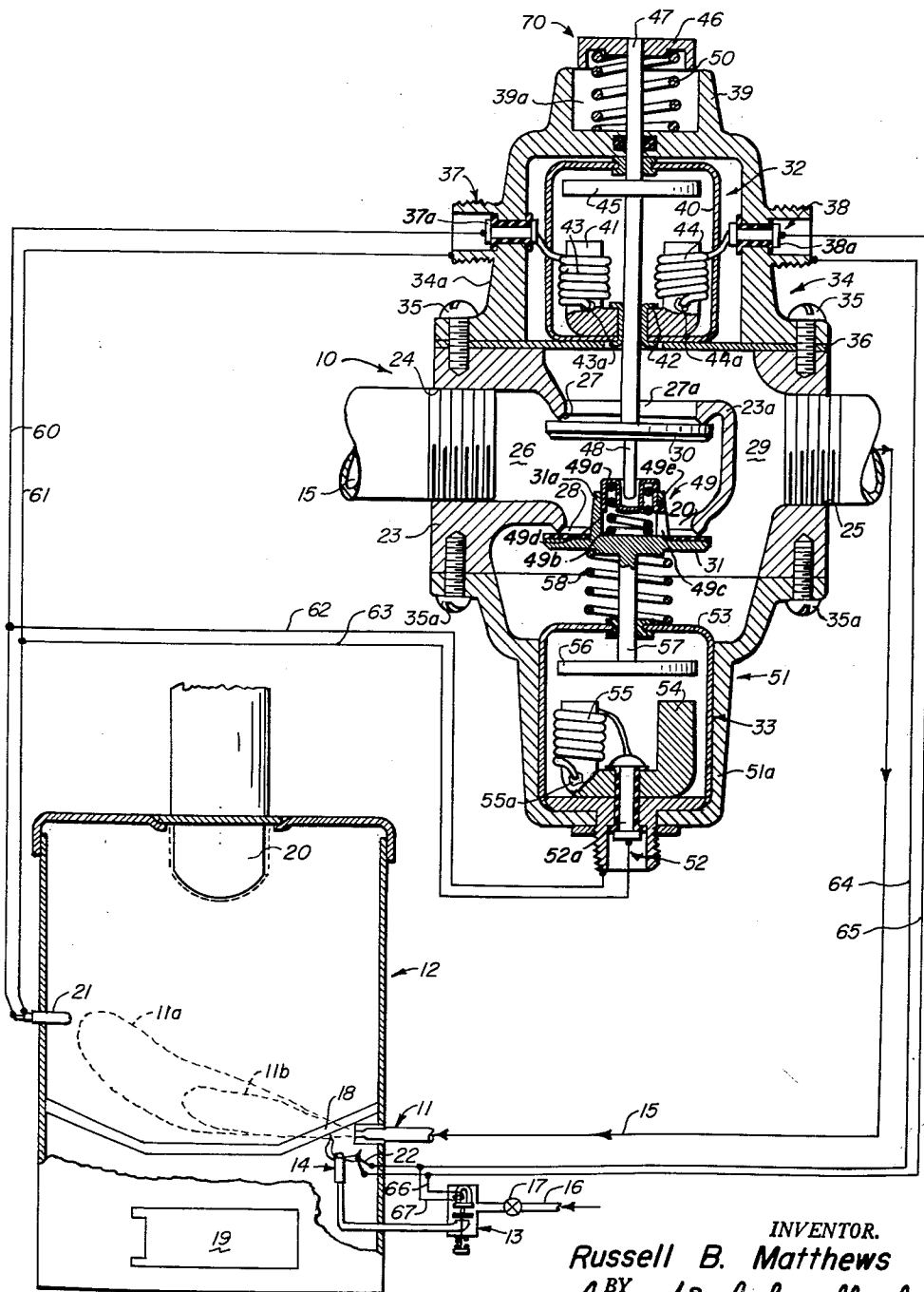
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CONTROL APPARATUS

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CONTROL APPARATUS

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This invention relates in general to control apparatus for fluid fuel burning systems and more particularly to fuel-control apparatus for gaseous fuel burning incinerators or the like.

In the control of gaseous fuel burning incinerators and the like, it has long been necessary to employ rather expensive controls such as timer mechanisms, etc., to shut down the fuel flow after a predetermined time lapse in addition to requiring other controls for safety function purposes.

It is a general object of this invention to provide a simple, safe, inexpensive control apparatus for fluid fuel burning incinerators and the like.

Another object of this invention is to provide apparatus, as the above characterized, which is responsive to consumption of the refuse within an incinerator to shut off the fuel flow thereto and, therefore, does not require complicated and expensive timing means.

Another object of the invention is to provide apparatus as aforementioned which is self-powered in that it is actuated by either the burning of fuel or the ignited refuse and therefore requires no other outside power.

A more specific object of the invention is to provide apparatus as aforementioned having a control member under the control of electromagnetic means responsive to both pilot burner operation and combustion of refuse.

Another object of the invention is to provide an incinerator control device as aforementioned which is operable to initially produce a high, hot flame in the incinerator for driving off moisture in the charge of refuse, permitting ignition thereof, there being temperature sensitive means operable on occurrence of an elevated temperature produced by said ignition to cause the control device to reduce the flame for the remainder of the incinerator cycle thereby conserving fuel.

Another object of the invention is to provide control apparatus substantially as set forth above wherein provision is made for automatically shutting off fuel flow if the incinerator is empty initially thereby affording a safety interlock and conserving fuel.

Another object of the invention is to provide control apparatus as set forth having safety means responsive to unsafe conditions, for example, unsafe pilot outage to effect 100% shut off of fuel flow to the incinerator.

Another object of this invention is to provide a control apparatus, as above described, that is compact in all dimensions, is well-adapted to mass manufacture, is easily installed by non-skilled technicians, and is otherwise well-adapted for purposes for which it was designed.

The novel features which are characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation together with additional objects and advantages thereof will best be understood by the following description of a specific embodiment when read in connection with the accompanying drawing, in which:

The sole FIGURE is a view, partially in section, of a specific embodiment of control apparatus constructed in accordance with the inventive concept, portions thereof being shown semi-diagrammatically.

A gaseous fuel burning incinerator 12 is shown in the lower left-hand portion of the drawing and apparatus for controlling the flow of gaseous fuel to the incinerator

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12 is shown in the upper right-hand portion of the drawing. More particularly, the apparatus generally comprises a main burner valve assembly 10 as shown which controls the fuel flow in a suitable conduit 15 leading to a main burner shown somewhat schematically at 11. A thermoelectrically powered safety shut-off pilot valve 13 controls the fuel flow in a separate conduit 16 leading to a pilot burner schematically illustrated at 14.

The main burner 11 may be of the jet type which when ignited by the pilot burner 14 supplies a flame to the interior of the incinerator 12 in accordance with the amount of fuel supplied thereto under pressure from a source (not shown) through conduit 15. The pilot burner is supplied by the same source of fuel as the main burner but pilot burner conduit 16 is taken off conduit 15 upstream of the main burner control device 10. A suitable manual valve 17 may, if desired, be disposed within the pilot supply conduit 16 to provide a separate shut off for the pilot fuel.

The incinerator 12 is shown somewhat diagrammatically and may be any particular type as suitable and may be any particular type as suitable and desired depending upon the particular application thereof. The incinerator may be formed with a grate 18 which is spaced slight above burner 11 and is formed with suitable apertures therein to permit the impingement of a main burner flame (shown at 11a and 11b) upon the refuse in the interior of the incinerator. The space below the grate is adapted to receive the ashes and non-combustibles of the incinerator charge which fall through the grate and collect in the bottom compartment in the usual manner. An ashes removal door 19 may be placed on an outer wall near the bottom of the incinerator to remove the ashes and non-combustibles and a smokestack or flue entry 20 is formed in the outer wall near the top to connect the interior of the incinerator to a suitable chimney as desired.

Returning now to the control or operator means 10 for the main burner 11, it is here shown in the form of a valve body 23 formed with an inlet 24, outlet 25 and a partition 23a which defines an inlet chamber 26 and an outlet chamber 29. The partition 23a may be formed with an upper opening 27a surrounded by an annular valve seat 27 and a lower outlet 20 surrounded by an annular valve seat 28 both of which lead, in separate parallel fuel flow paths, to the outlet chamber 29.

A pair of valve discs 30 and 31 are disposed to co-operate respectively with valve seats 27 and 28 to control the fuel flow through the main outlet 25 in accordance with the controlling action of operator means 32 and 33 to be presently described. When both valve discs 30 and 31 are spaced from their respective seats 27 and 28, a relatively high capacity flow to outlet 25 results, producing a relatively high hot flame 11a at burner 11. On the other hand, when valve disc 31 is spaced from its seat and valve disc 30 is seated, a relatively low capacity fuel flow is afforded to the burner 11 to produce a much smaller flame 11b.

The operator means or resettable coupling means for the valves 30 and 31 are indicated generally at 32 and 33, coupling means 32 being normally operable to control the position of both valve discs 30 and 31 as shall become apparent. Resettable holding means or coupling means 33 is normally operable to control, under certain predetermined conditions, the position of valve disc 31. It is to be noted that a single reset means 70 cooperates with and resets both the coupling means 32 and 33 as shall become apparent.

More particularly, the coupling means 32 is a part of a separate subassembly indicated at 34 which is fixedly and sealingly mounted on valve body 23 by suitable fastening means such as bolts 35. The subassembly 34 com-

prises a casing 34a which is generally cup-shaped in configuration having electrical terminal connecting means 37 and 38 suitably formed in the opposite side walls thereof, the upper wall of the casing 34a being formed with an upstanding boss 39 having a bore 39a therein and which will be further described hereinafter. The electric connection means 37 and 38 each comprise an insulated terminal socket formed on casing wall 34a having central insulated inner connectors 37a and 38a, respectively, which sealingly extend through the walls for connection to windings 43 and 44 as shall be later described.

The open end of cup-shaped casing 34a may be closed by an apertured rigid supporting plate 36. Fixedly mounted on support plate 36 within the casing 34a is a cylindrical housing means 40 which contains therein a generally U-shaped magnet core 41 which may be fixedly mounted to said housing 40 by flanged sleeve or tubular rivet 42 which also serves as a stem bearing as shall become apparent.

Separate energizing coils or windings 43 and 44 are wound on the upstanding legs of magnet frame 41 in opposing non-aiding relationship, i.e., when both coils are simultaneously energized the flux generated by one in effect cancels that generated by the other, so as to produce the same effect as though both windings were de-energized. One end of coil 43 may be grounded to the core at 43a and the other end may be connected as aforementioned to the central connector 37a of connection means 37, the latter being connected to an energizing source as shall be later explained. One end of winding 44 may be grounded as at 44a and the other end may be connected to the terminal connector 38a of connection means 38 for connection to an energizing source by circuitry to be later described. A disc type armature 45 is also disposed within the housing 40 for coaction with the pole faces of magnet 41, the latter being operable to retain the armature 45 in attracted relation after movement thereto by suitable reset means 70.

The reset means 70 comprises a reset button 46 which is mounted on the outer end of a stem 47, the latter mounting the armature 45 to move it into engagement with pole faces of magnet 41 upon depression of the button 46. As shown the reset stem 47 extends inwardly beyond the armature 45 and slidably extends through the bearing sleeve 42 and casing 34a to carry valve disc 30 for movement simultaneously with said armature. The reset stem 47 is biased upwardly, as shown in the drawing, by a coil compression spring 50 which is interposed between the reset button 46 and the bottom surface of bore 39a of boss 39. Thus, the armature 45 is biased toward retracted position with respect to electromagnet 41 and valve disc 30 is biased toward engagement with seat 27. It is to be noted that magnet 41 is never operative to attract armature 45 against the bias of spring 50 from the retracted position shown in the drawing.

The coupling or holding means 33 for the valve disc 31 may be very similar to holding or coupling means 32, the essential difference being that the magnet therein has only one energizing coil associated therewith. More particularly, the coupling means 33 is a part of a lower subassembly 31 having a generally cup-shaped body 51a. The body 51a may be formed having a terminal connection means 52 extending from the bottom wall thereof as shown in FIGURE 1. Fixedly mounted within the body 51a is a generally cylindrical housing 53 which contains a fixed generally U-shaped magnet frame 54 having an energizing winding 55 thereon. The magnet frame 54 is fixedly mounted with respect to the rest of the parts by a terminal rivet means 52a which insulatably extends through the bottom portion of the U-shaped magnet to clampingly hold the parts in assembled relation and also serves as a central insulated inner terminal connector for the energizing winding 55. The other end

of winding 55 is grounded to the magnet frame at 55a. The electrical connection means 52 is adapted to be connected to an energizing source in a manner as shall be later described.

A movable armature 56 cooperates with the pole faces of magnet 54 within the housing 53, and a stem 57 slidably extends through a suitable opening in the end wall of the housing 53 and connects the armature 56 to the valve disc 31. A suitable coil compression spring 58 surrounds stem 57, one end engaging the housing 53, and the other engaging valve disc 51 to bias the latter toward seat 28 and armature 57 toward retracted relation with respect to magnet frame 54.

As aforementioned the reset means 70 for the device 10 is operable to reset both armatures and to thereby move both valves to open position. To afford the resetting of the lower coupling means 33 the stem 47 has a portion 48 extending downwardly from the valve disc 30, the end of which coacts with a lost motion overtravel spring retained assembly 49 which is formed on the upstream side of valve disc 31 as shown in the drawing. The overtravel spring assembly 49 comprises a tubular boss 31a on valve disc 31 which is formed with a side wall aperture 49c and a bore 49d. A recessed button 49a is adapted to slidably move within bore 49d and has a flared portion 49e which coacts with the side wall aperture 49c to prevent the button 49a from leaving said bore. A coil compression spring 49b is interposed between the bottom surface of bore 49d and button 49a to bias the latter outwardly and to bias flared portion 49e into engagement with the uppermost surface of aperture 49c. The spring 49b is preferably much stronger than spring 58.

Depression of reset armature and valve stem 47 causes simultaneous resetting of both valves 30 and 31 and armatures 45 and 56 against the bias of both springs 50 and 58. Spring 49b of assembly 49 takes up any overtravel that is needed for production tolerances.

Turning now to the pilot burner safety shut-off valve means 13 and the supply pipe 16. It is to be noted that valve means 13 is shown somewhat schematically and is very similar to the lower coupling means 33, i.e., it comprises an electromagnet and a resettable armature and valve biased toward retracted and closed position respectively, the latter being held open and in an attractive position respectively by an energized winding on said electromagnet after movement thereto by suitable reset means.

The electrical circuitry of the apparatus, as shown, comprises a sensing thermocouple or thermoelectric generator 21 which is located on an interior wall of the incinerator 12 in a position such that when the incinerator is empty the high flame 11a afforded by both valve discs 30 and 31 being open impinges directly upon said generator 21. The generator 21 is connected to inner terminal connector 37a of connector means 37 by a suitable conductor 60 and the return connector 61 is suitably connected to the outside of the socket portion of the connector means 37 as shown. Thus the generator 21 is operable to energize, under certain energizing conditions, coil 43 of the coupling means 34, the circuit being through conductor 60, coil 43, magnet frame 41, tubular casing 40, support plate 36, casing wall 34a and return conductor 61. The winding 55 of the lower coupling means 33 is connected in parallel circuit relationship to the aforementioned winding 43 by suitable conductors 62 and 63, the latter being connected to inner rivet terminal 52a and the former being connected to the outside of the socket to complete the connection through the magnet frame and lower casing member 51a.

Winding 44 of the upper coupling means 32 is connected for energization by a suitable conductor 65 which is connected to inner terminal 38a and a return conductor 64 which is connected to the outside of casing 34a. The other ends of conductors 64 and 65 are connected to a thermocouple or thermoelectric generator 22 which

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is positioned to be heated by the flame of the pilot burner 14. As shown, the pilot burner thermoelectric safety shut-off means 13 is connected in parallel circuit relationship to winding 44 by suitable conductors 66 and 67.

The thermoelectric generators 21 and 22 are of any suitable and desired type, one such being set forth in the copending application of Robert W. Fritts and Sebastian Karrer, Serial No. 618,063, filed October 24, 1956, and assigned to the assignee of the present invention.

For purposes of the present application, suffice it to say, that the generators 21 and 22 are operable, when the hot junctions thereof are heated to a predetermined elevated temperature to energize the two energizing coils connected to each generator, i.e., generator 21 is operable when heated to a predetermined elevated temperature to energize both windings 55 and 43 and generator 22 is operable when heated by a normal pilot flame to energize winding 44 and the winding of the safety shut-off valve 13. However, it is to be specifically noted that windings 43 and 55 which are in parallel, are so arranged that winding 43 energizes sufficiently to drop out armature 45 after winding 55 has created sufficient flux to retain armature 56. Stated another way, as the temperature of the incinerator increases, the E.M.F. developed by the generator 21 increases and at one predetermined temperature, sufficient E.M.F. is developed to retain armature 56 in attracted relation and at a predetermined higher elevated temperature, sufficient E.M.F. is developed in winding 43 to nullify the attractive force created by winding 44. Thus armature 56 is retained in attracted relation prior to drop out of armature 45 under the bias of spring 50.

Operation

Assume the following initial conditions: Pilot burner 14 ignited and energizing thermoelectric generator 22 which, in turn, maintains pilot safety shut-off thermoelectrically powered valve 13 in open condition and also energizes winding 44 of coupling means 32; thermoelectric generator 21 in the interior of the incinerator 12 cold; and valve discs 30 and 31 engaging seats 27 and 28 respectively to prevent any fuel flow to the main burner 11. Further, assume that the charge of refuse is deposited on the grate 18 of the incinerator.

To start the device in operation, the reset button 46 is depressed resetting armature 45 to the pole faces of magnet 41 and simultaneously resetting armature 56 into engagement with the pole faces of magnet 54. Coil 44 of coupling means 32 is energized and retains armature 45 in attractive relation against the combined bias of springs 50 and 58. The reason that armature 45 must hold against the combined bias of both springs is that no other coil is energized at this time. The resetting operation opens both valve discs and fuel is now permitted to flow through both valve seats 27 and 28 to the main burner 11 to give a relatively high fuel flow which is ignited by the pilot burner to produce a high flame 11a.

The refuse within the interior of the incinerator will now be subjected to the hot flame 11a to drive off moisture therein, and as the moisture is driven off, the refuse ignites and causes the relatively high temperature within the interior of the incinerator 12. Elevation of the temperature within the incinerator causes sensing thermoelectric generator 21 to become energized to, in turn, energize the magnet windings 55 and 43 associated respectively with coupling means 33 and 32. As aforementioned, the thermoelectric circuitry and the windings 55 and 43 are such that winding 55 becomes energized sufficiently to retain armature 56 in attractive relation to magnet frame 54 prior to sufficient opposition flux being provided by coil 43 to release the armature 45 of coupling means 32. Thus, when armature 45 of coupling means 32 is released to cause seating of disc 30 under the bias of spring 50, the valve disc 31 is retained in open position by the energized coupling means 51. Seating of disc 30 permits a lesser amount of fuel to be supplied

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to the main burner 11 and affords a lower flame 11b, said lesser amount of fuel through the valve seat 28 continuing to flow until such time as the refuse within the incinerator 12 is consumed. Once the refuse has become ignited, the lower flame 11b is sufficient for continued operation and the lower capacity required therefor.

Consumption or burning of the refuse causes a reduction in the temperature within the incinerator 12 from the aforementioned elevated level obtaining during the burning of the refuse. The reduction in temperature is reflected in a reduction in the E.M.F. produced by sensing thermoelectric generator 21 to below the drop-out value of the coupling means 33 whereupon the armature 56 is released and valve disc 31 seats on valve seat 28 under the bias of spring 50 to shut off all fuel flow to the burner 11. For safety reasons and also to conserve fuel, the thermoelectric circuitry and fuel flow passages are so designed that when both valve discs 30 and 31 are spaced away from their respective seats 27 and 28, a high flame 11a is produced such that if the incinerator is empty the flame 11a is alone sufficient to elevate the temperature surrounding generator 21 high enough to effect energization of windings 55 and 43 and closure of valve disc 30. The lesser flame 11b thus produced provides insufficient heat to maintain the temperature at generator 21 at the elevated level required to maintain the millivoltage output from said generator above the drop-out value of the coupling means 33. As a result, the armature 56 is released and valve disc 31 seats under the bias of spring 58 to shut off all fuel flow to the main burner 11.

The form of the invention selected for illustration is used for purpose of disclosure only and is not intended to impose unnecessary limitations on the claims or to confine the patented invention to a particular use. Various changes and modifications may be made without departing from the spirit of the invention and all such changes are contemplated as may come within the scope of the claims.

What is claimed as the invention is:

1. Control apparatus comprising control means having a first position and having means biasing the same toward a second position, first and second releasable coupling means movable between coupled and released relation operatively associated with said control means and each being operable when coupled to hold said control means in said first position against the bias of said biasing means, first electroresponsive means energizable to retain said first coupling means in coupled relation when moved thereto, second electroresponsive means energizable to oppose said first electroresponsive means and release said first coupling means from retention in coupled relation by energization of said first electroresponsive means, said second coupling means including third electroresponsive means energizable to retain said second coupling means in coupled relation when moved thereto, first source means connected in circuit with said first electroresponsive means, and second source means connected in circuit with both said second and said third electroresponsive means for simultaneous energization thereof, movement of said control means to its first position and of said first coupling means to coupled relation while said first source means is operative effecting coupling of said first coupling means and retention thereby of said control means in its first position, and subsequent operation of said second source simultaneously with said first source effecting coupling of said second coupling means and release of said first coupling means, whereupon said control means is thereafter held in its first position by said second coupling means as long as said second source is operative.

2. Control apparatus comprising a valve member having an open position and having means biasing the same toward a closed position, first and second releasable electromagnetic coupling means movable between coupled and released relation operatively associated with said

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valve member and each being operable when coupled to hold said valve member in open position against the bias of said biasing means, first coil means energizable to retain said first coupling means in coupled relation when moved thereto, second coil means opposing said first coil means and operable when energized to release said first coupling means from retention in coupled relation by energization of said first coil means, third coil means operable when energized to retain said second coupling means in coupled relation when moved thereto, first source means connected in circuit with said first coil means, and second source means connected in circuit with both said second and said third coil means for simultaneous energization thereof, movement of said valve member to open position and of said first coupling means to coupled relation while said first source only is operative effecting coupling of said first coupling means and retention thereby of said valve member in open position, and subsequent operation of said second source simultaneously with said first source effecting coupling of said second coupling means and release of said first coupling means, whereupon said valve member is thereafter held in open position by said second coupling means as long as said second source is operative.

3. Control apparatus comprising first and second control means each having a first position and having means biasing the same toward a second position, first and second releasable coupling means movable between coupled and released positions operatively associated with said first and second control means respectively and each being operable when coupled to hold the associated control means in its first position against its biasing means, said first coupling means also being operatively associated with said second control means and operable when coupled to hold said second control means in its first position against its biasing means, first electroresponsive means energizable to retain said first coupling means in coupled relation when moved thereto, second electroresponsive means energizable to oppose said first electroresponsive means and release said first coupling means from retention in coupled relation by energization of said first electroresponsive means, said second coupling means including third electroresponsive means energizable to retain said second coupling means in coupled relation when moved thereto, said third electroresponsive means being connected in circuit with said second electroresponsive means for energization simultaneously therewith, means for resetting both of said coupling means to coupled relation and thereby each of said control means to their first position, operation of said reset means while said first electroresponsive means is energized effecting coupling of said first coupling means and retention thereby of both of said control means in their first position, and subsequent simultaneous energization of all of said electroresponsive means effecting coupling of said second coupling means and release of said first coupling means, whereupon said first control means is moved to its second position under the bias of its biasing means and thereafter said second control means is held in its first position by said second coupling means as long as said third electroresponsive means is energized.

4. Control apparatus comprising parallel first and second flow passage means, first and second valve members respectively controlling flow through said first and second flow passage means and each having an open position and having means biasing the same toward a closed position, first and second releasable electromagnetic coupling means operatively associated with said first and second valve members respectively and each being operable when coupled to hold the associated valve member in open position against its biasing means, said first coupling means also being operatively associated with said second valve member and operable when coupled to hold said second valve member in open position against its biasing means, first coil means energizable to retain said first

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coupling means in coupled relation when moved thereto, second coil means energizable to oppose said first coil means and release said first coupling means from retention in coupled relation by energization of said first coil means, said second coupling means including third coil means energizable to retain said second coupling means in coupled relation when moved thereto, said third coil means being connected in circuit with said second coil means for energization simultaneously therewith, means for resetting both of said coupling means to coupled relation and thereby each of said valve members to open position, operation of said reset means while said first coil means is energized effecting coupling of said first coupling means and retention thereby of both of said valve members in open position, and subsequent simultaneous energization of all of said coil means effecting coupling of said second coupling means and release of said first coupling means whereupon said first valve member is moved to closed position under the bias of its biasing means and thereafter said second valve member is held in open position by said second coupling means as long as said third coil means is energized.

5. An electroresponsive valve for controlling fluid fuel flow comprising a valve body having first and second fuel passage means arranged in parallel flow relation and each having a valve seat therein, first and second flow-control members each having an open position and having means biasing the same toward a closed position with respect to said valve seats respectively to afford when both members are in open position a high level of fuel flow and when one control member only is in open position a low level of fuel flow through said valve body, first and second releasable electromagnetic coupling means operatively associated with said first and second control members respectively and each being operable when coupled to hold the associated flow-control member in open position against the bias of its biasing means, said first coupling means also being operatively associated with said second flow control member and operable when coupled to hold said second flow-control member in open position against the bias of its biasing means, first coil means energizable to retain said first coupling means in coupled relation when moved thereto, second coil means energizable to oppose said first coil means and release said first coupling means from retention in coupled relation by energization of said first coil means, said second coupling means including third coil means energizable to retain said second coupling means in coupled relation when moved thereto, said third coil means being connected in circuit with said second coil means for energization simultaneously therewith, means for resetting both of said coupling means to coupled relation and thereby each of said control members to open position, operation of said reset means while said first coil means is energized effecting coupling of said first coupling means and retention thereby of both of said control members in open position to afford a high level of fuel flow, and subsequent simultaneous energization of all of said coil means effecting coupling of said second coupling means and release of said first coupling means whereupon said first control member is moved to closed position under the bias of its biasing means and thereafter said second control member is held in open position by said second coupling means to afford a low level of fuel flow through said valve body as long as said third coil means is energized.

6. Apparatus for the control of fluid fuel flow to a burner, comprising a control body having an inlet and having an outlet adapted for connection to a burner to be supplied with fluid fuel, said control body also having parallel first and second flow passage means connecting said inlet to said outlet, a high flame control member in said first flow passage means having means biasing the same toward a closed position and being movable to an open position, a low flame control member in said second flow passage means having means biasing the same

toward a closed position and being movable to an open position, manual reset means operable to move both flow-control members to open position simultaneously, means operable to retain both said control members in open position when moved thereto, and means associated with said last named means and responsive to a predetermined condition to cause said retaining means to release said high flame control member for movement to closed position under the bias of its biasing means while retaining said low flame control member in open position.

7. In an apparatus for the control of fluid fuel, a burner, control means in the path of fuel flow to said burner comprising means defining first and second parallel flow passage means, a high flame flow-control member in said first flow passage means having means biasing the same toward a closed position and being movable to an open position with respect to fuel flow through said first passage means, a low flame flow-control member in said second flow passage means having means biasing the same toward a closed position and being movable to an open position with respect to fuel flow through said second flow passage means, manual reset means operable to move both flow-control members to open position simultaneously to provide a high flame producing fuel flow to said burner, means operable to retain both said control members in said open position when moved thereto, and means associated with said last named means and responsive to the existence of a high flame at said burner to cause said retaining means to release said high flame control member for movement to closed position under the bias of its biasing means while retaining said low flame control member in open position to provide a low flame producing fuel flow to said burner.

8. In combination first and second control members each having a first controlling position and having means biasing the same toward a second controlling position, means inter-connecting said control members and operable to insure disposition of said second control member in its first controlling position when said first control member is in its first controlling position, first and second electromagnetic operator means operatively connected to said control members respectively and each including coupling means movable between coupled and released relation with movement of the associated control member from its first toward its second controlling position, the coupling means of said first operator means including first coil means operable when energized to retain the coupling means of said first operator means in coupled relation and said first control member in its first controlling position when moved thereto, the coupling means of said first operator means also including second coil means operable when energized simultaneously with said first coil means to effect release of said first operator coupling means, the coupling means of said second operator means including third coil means operable when energized to retain said second operator coupling means in coupled relation and said second control member in its first controlling position when moved thereto, first electrical energy source means connected in circuit with said first coil means for energization thereof, and second electrical energy source means connected in

circuit with both said second and said third coil means for simultaneous energization thereof, operation of said second source means while said first and second control members are being held in their first controlling positions by operation of said first source means effecting release of said first operator coupling means and movement of said first control member toward its second controlling position under the bias of its biasing means and simultaneous retention of said second control member in its first controlling position by said second coupling means.

9. Control apparatus comprising means defining parallel first and second flow passages, first and second valve members respectively controlling flow through said first and second flow passage means and each having an open position and having means biasing the same toward a closed position, means interconnecting said valve members and operable to insure disposition of said second valve member in open position when said first valve member is in open position, first and second electromagnetic operator means operatively connected to said valve members respectively and each including coupling means movable between coupled and released relation with movement of the associated valve member from open toward closed position, the coupling means of said first operator means including first coil means operable when energized to retain the coupling means of said first operator means in coupled relation and said first valve member in open position when moved thereto, the coupling means of said first operator means also including second coil means operable when energized simultaneously with said first coil means to effect release of said first operator coupling means, the coupling means of said second operator means including third coil means operable when energized to retain said second operator coupling means in coupled relation and said second valve member in open position when moved thereto, first electrical energy source means connected in circuit with said first coil means for energization thereof, and second electrical energy source means connected in circuit with both said second and said third coil means for simultaneous energization thereof, operation of said second source means while said first and second valve members are being held in open position by operation of said first source means effecting release of said first operator coupling means and movement of said first valve member toward closed position under the bias of its biasing means and simultaneous retention of said second valve member in open position by said second coupling means.

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