United States Patent [19]

Katchka

[11] **3,768,332**

[45] **Oct. 30, 1973**

[54] **DUAL LEVER MECHANISM**

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[73] Assignee: **Robertshaw Controls Company,** Richmond, Va.

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[21] Appl. No.: **333,590**

Related U.S. Application Data

[62] Division of Ser. No. 162,556, July 14, 1971, Pat. No. 3,747,617.

[52] **U.S. Cl.** **74/491,** 74/101, 74/519

[51] **Int. Cl.** **G05g 1/00**

[58] **Field of Search** ..... 74/491, 99, 101, 74/519, 479, 480 R

[56] **References Cited**

UNITED STATES PATENTS

3,304,797 2/1967 Graveley 74/491

Primary Examiner—Milton Kaufman
Assistant Examiner—Frank H. McKenzie, Jr.
Attorney—Anthony A. O'Brien

[57] **ABSTRACT**

Dual lever mechanisms especially well suited for use in a combination control device for gas burner apparatus having a reset operator, an electromagnetic holding device and a safety valve member, the dual lever mechanisms including a first lever having one arm actuated by the reset operator, a second arm engaging the magnet armature and a third arm spaced from the second arm and movable into engagement with a second lever for the safety valve member and pivoted in common with the first lever; lost motion is provided between the first and second levers such that the second lever is not engaged by the third arm of the first lever until the final movement of the reset operator whereupon the valve member is lifted from its seat a slight amount thereby permitting the pressure differential experienced across the valve to be balanced. A torsion spring for the second lever thereafter moves the second lever so as to fully open the safety valve.

2 Claims, 9 Drawing Figures

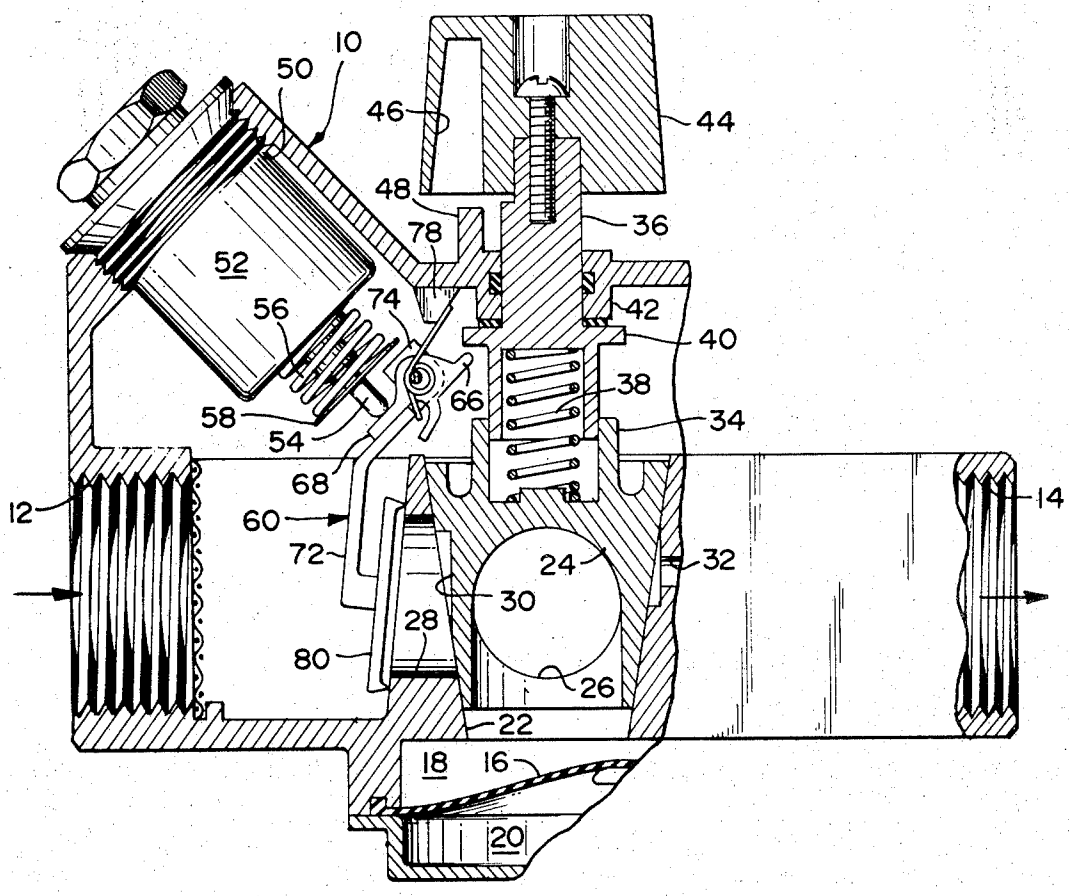


FIG. 1

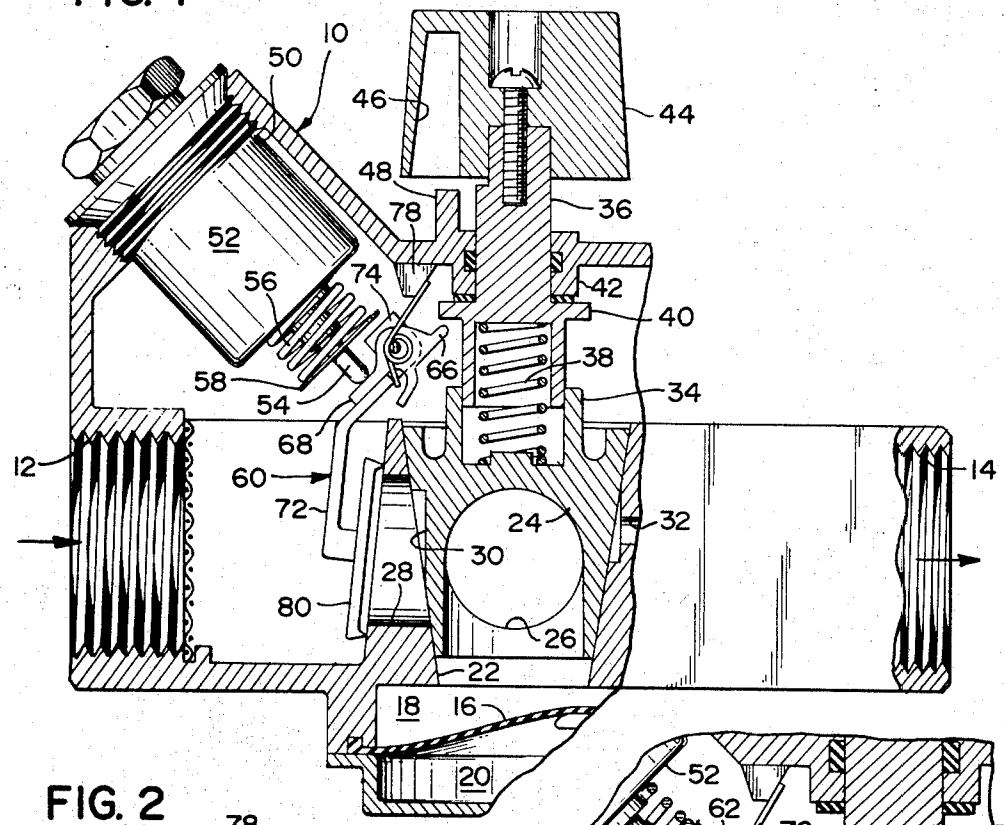
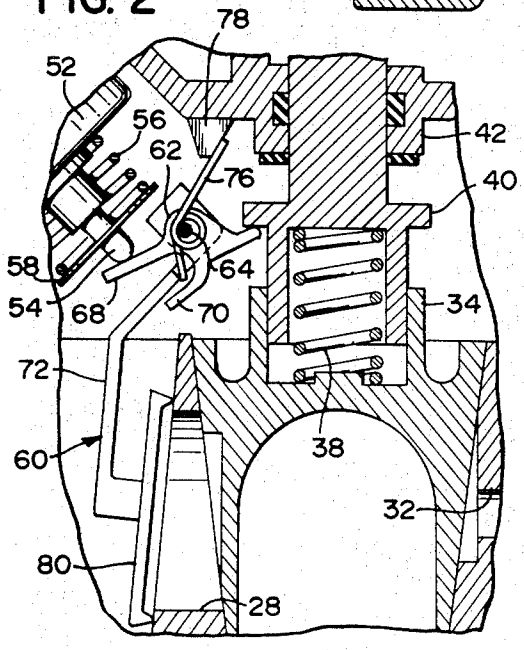


FIG. 2



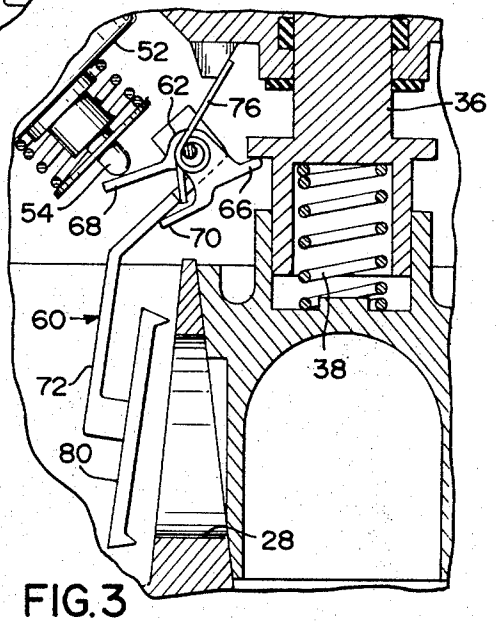


FIG. 3

FIG. 4

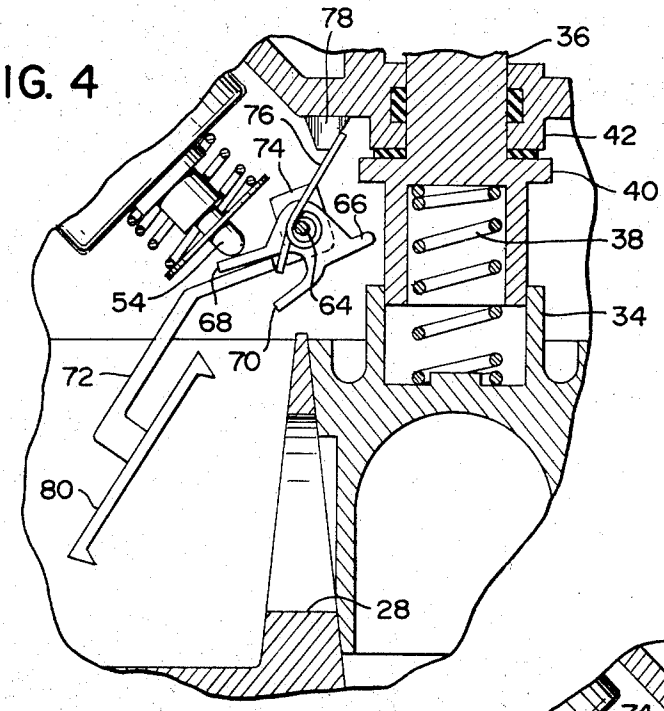


FIG. 5

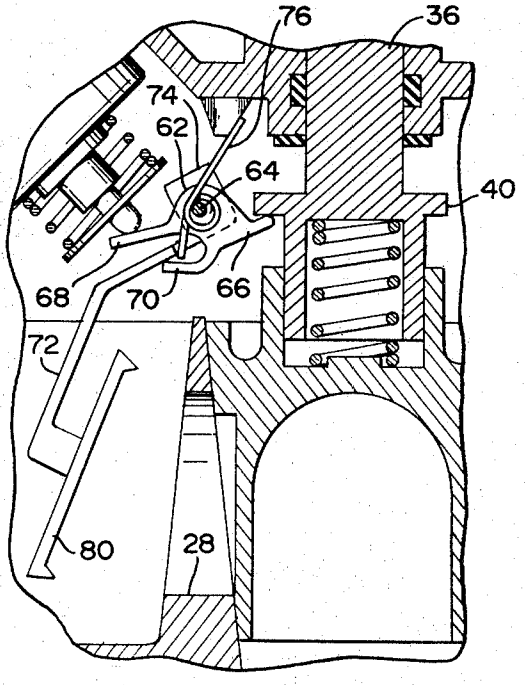


FIG. 6

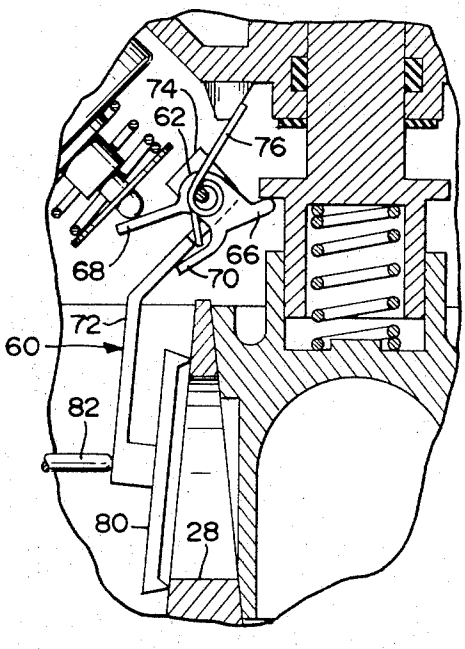


FIG. 8

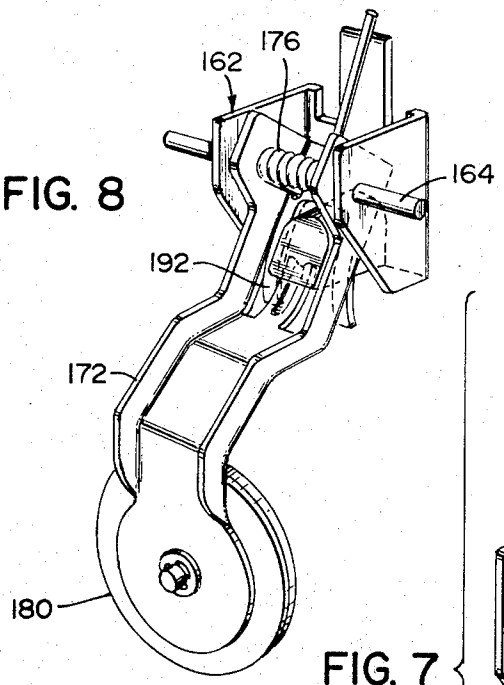


FIG. 7

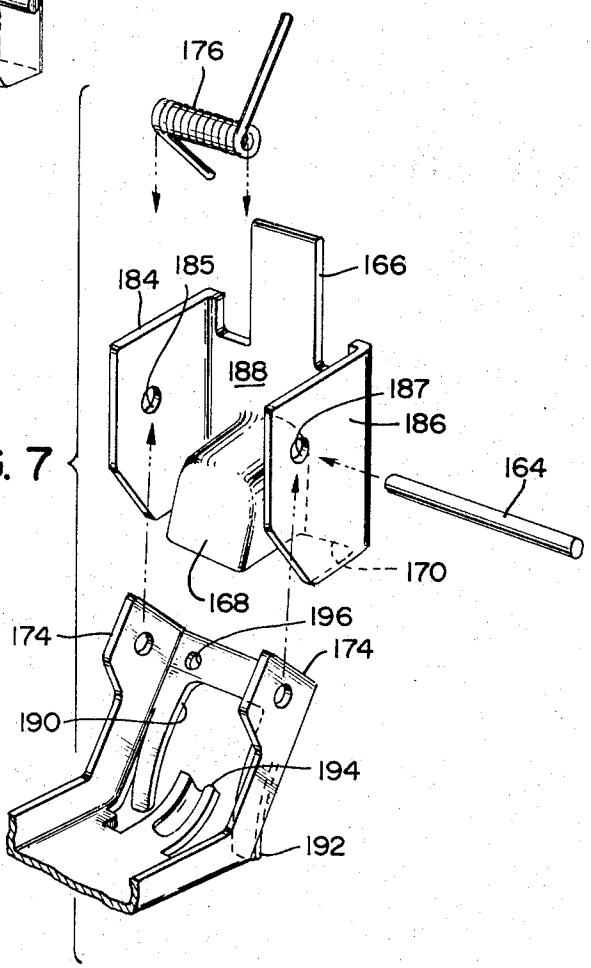
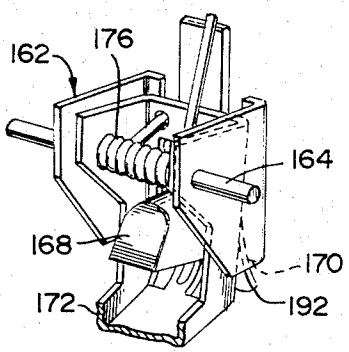


FIG. 9



DUAL LEVER MECHANISMS

CROSS REFERENCE TO RELATED APPLICATION

This is a divisional application of pending application Ser. No. 162,556 filed July 14, 1971 now U.S. Pat. No. 3,747,617.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to lever mechanisms and more particularly to a dual lever mechanism for a safety valve member in a gas burner control device which prevents damage to the valve assembly during operation.

2. Description of the Prior Art

The prior art, as exemplified by U. S. Pat. No. 2,815,034, No. 2,817,973 and No. 2,831,491, is generally cognizant of dual lever assemblies for control devices used in connection with burner apparatus to provide sequential operation of two loads upon manual resetting of the control. As exemplified by the above patents, the prior art dual lever assemblies have been used typically to sequence the opening of a pilot valve and a separate main flow valve for safety purposes. With the advent of improved combination control devices which utilize only a single safety valve, as illustrated by U. S. Pat. No. 3,513,873, the need for such prior art lever mechanisms for the most part has been obviated; however, it has been found that the use of excessive force in resetting these single safety valve control devices has often caused damage to the valve, the valve lever or the electromagnetic holding assembly associated therewith. A practical solution to this problem, either through the use of a conventional dual lever mechanism or any other technique, heretofore has not been realized and the lack of such a feature has proven to be a distinct disadvantage especially in view of resulting maintenance and repair costs.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to actuate two loads sequentially by means of a dual lever mechanism which exhibits lost motion so as to isolate one of the loads from excessive actuating force.

The present invention is summarized in a dual lever mechanism including a shaft, a first lever intermediately disposed on the shaft and having a first arm extending from one end thereof and second and third spaced arms extending in a direction opposite that of the first arm from the other end thereof, and a second lever journaled for rotation at one end on the shaft and having a portion thereof disposed between the second and third arms of the first lever for selective engagement by the second and third arms whereby the first and second levers exhibit lost motion coupling therebetween.

The present invention has another object in that a safety valve in a gas control device is only slightly opened in response to actuation of a manual operator and thereafter is completely opened independently of the manual operator by a biasing spring.

A further object of this invention is to transmit the full movement of a rest plunger to a resettable holding device and only a terminal portion of such movement to a safety valve member associated with the holding device.

Another object of the present invention is to easily and precisely calibrate a dual lever mechanism for a safety valve in a control device used in connection with burner apparatus.

Other objects and advantages of the present invention will become apparent from the following description of the preferred embodiments when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial sectional view of burner control apparatus embodying a dual lever mechanism according to the present invention showing the lever mechanism in a first operative position;

FIG. 2 is a partial section of the apparatus of FIG. 1 showing the dual lever mechanism in a second operative position;

FIG. 3 is a partial section similar to FIG. 2 showing the dual lever mechanism in a third operative position;

FIG. 4 is a partial section similar to FIG. 2 showing the dual lever mechanism in a fourth operative position;

FIGS. 5 and 6 are partial sections similar to FIG. 2 illustrative of a method of calibrating the dual lever mechanisms according to the present invention;

FIG. 7 is a partial exploded view of a modification of the dual lever mechanism of FIG. 1;

FIG. 8 is a perspective view of the dual lever mechanism of FIG. 7 in one operative position; and

FIG. 9 is a partial perspective view similar to FIG. 8 showing the dual lever mechanism of FIG. 7 in another operative position.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

While the present invention is applicable to various types of control assemblies, it will be described in connection with a combination control device for burner apparatus of the heating type for illustrative purposes only. As illustrated in FIGS. 1 through 4, the present invention is embodied in a combination control device having a hollow casing indicated generally at 10 and defining an inlet port 12 on one end adapted to be connected to a suitable fuel supply such as a gas source (not shown) and a main outlet port 14 on an opposite end adapted to be connected with a main gas burner (not shown) by a suitable conduit. Interposed in a passageway between inlet port 12 and outlet port 14 is a main valve seat which is controlled by a flexible diaphragm defining a main valve member 16. The periphery of the diaphragm valve 16 is clamped between adjacent sections of the casing 10, which are secured together as by cap screws (not shown). The main diaphragm valve 16 separates a hollow cavity of the casing into an inlet pressure chamber 18 and an operating pressure chamber 20. The diaphragm valve 16 is spring biased against its valve seat and is controlled in operation by the pressure differential between pressure chambers 18 and 20 under the influence of a bleed flow passage (not shown) which communicates with chamber 20.

The inlet pressure chamber 18 communicates with inlet 12 by means of a tapered conical bore 22 which defines a seat for a rotatable plug valve 24 having a similarly tapered conical configuration. The central portion of plug valve 24 is hollowed out and has an open bottom wall communicating with the inlet pressure

chamber 18. Intermediate its ends, the tapered wall of plug valve 24 has an inlet bore 26 for selective registry with an inlet passage 28 in the casing 10. An arcuate groove 30 in the wall of plug valve 24 establishes communication between the inlet passage 28 and a pilot flow passage 32 which feeds a suitable pilot burner (not shown) through a pilot flow filter cavity, an outlet and a suitable conduit.

The large end of the plug valve 24 includes a hollow stem 34 in which an operating shaft 36 is keyed for relative axial movement and for unitary rotatary movement therebetween. The shaft 36 also has a hollow portion seating a coil spring 38 that is mounted in compression between the stem 34 and shaft 36. An annular shoulder 40 on the shaft 36 engages an internal wall 42 in the casing 10 to define the limit of axial movement of the shaft 36 by spring 38. The shaft 36 protrudes through the casing 10 and has a manual operating dial or knob 44 fixed onto the end thereof. The undersurface of the dial 44 is partially recessed at 46 to receive a stop member 48 on the casing 10 whereby the dial 44 may be only fully depressed when it is in its "pilot" position as illustrated; when the dial 44 is rotated to its "off" or "on" positions, the stop element 48 prevents full depression of the dial 44.

Adjacent the manual dial 44, the casing 10 defines an internally threaded aperture 50 in which a magnet housing 52 is fixedly supported. As is well known in the art, a thermal electromagnet in the housing 52 is electrically connected to a thermocouple (not shown) to constitute a safety holding device. The thermocouple is conventionally disposed adjacent the pilot burner for the system and is responsive to a flame thereat to generate a thermoelectric voltage which feeds the electromagnet in housing 52. The electromagnet in housing 52 includes an axially movable armature 54 which protrudes out of the magnet housing 52 interiorly of the casing 10 as shown. A coil spring 56 surrounds the protruding portion of the armature 54 and is mounted in compression between the wall of the housing 52 and a retainer washer 58 which is secured to the free end of armature 54.

One embodiment of a dual lever mechanism in accordance with the present invention is illustrated in FIGS. 1 through 4 in various operative positions with respect to the above-described combination control device and is indicated generally at 60. The dual lever mechanism 60 includes a first lever 62 which is journaled for rotation about a pivot pin 64 which is mounted for rotary movement in suitable apertures in the casing 10. Lever 62 has a first arm 66 disposed in the path of axial movement of the annular shoulder 40 on the shaft 36 whereby depression thereof by the dial 44 causes the lever 62 to pivot clockwise about pivot pin 64. A second arm 68 of lever 62 extends in the opposite direction of arm 66 for engaging the magnet armature 54 and a third arm 70 extends in substantially parallel spaced relation with arm 68 for movement into engagement with a second lever 72. One end of lever 72 is bifurcated to accommodate lever 62 and has a pair of upstanding mounting tabs 74 which are disposed on either side of lever 62 and are journaled for rotation about pivot pin 64. A torsion spring 76 is coiled about pivot pin 64 and engages lever 72 at a first end and contacts a stop element 78 on casing 10 at its other end so as to bias lever 72 for clockwise rotation. The opposite end of lever 72 carries a safety valve member 80 which seats against the wall surrounding inlet passage 28.

In operation, FIG. 1 illustrates the dual lever assembly 60 in a first or "closed" position with plug valve 24 set to its "pilot" position. With valve 80 closed, as shown, no gas can pass from inlet 12 to outlet port 14 for supplying the main and pilot burners of the burner apparatus. At this time, spring 38 biases shaft 36 outwardly of casing 10 such that annular shoulder 40 abuts internal wall 42 and is disengaged from arm 66 of lever 62. With arm 66 disengaged, the high-rate spring 56 of housing 52 acts through washer 58, the end of armature 54 and arm 68 of lever 62 to rotate lever 62 counterclockwise whereupon the undersurface of arm 68 engages lever 72 to rotate it counterclockwise thus closing valve 80 against its seat. With lever 72 in its counterclockwise position, torsion spring 76 is wound-up such that it applies a force to lever 72 which tends to rotate the lever in a clockwise direction. Opposing the force of tension spring 76 is the force from high-rate spring 56, as noted above, and the force of the gas pressure differential across valve 80. Thus, the single force from torsion spring 76 tends to "open" valve 80, while the combined forces of high-rate spring 56 and the gas pressure differential across valve 80 tend to "close" the valve.

When it is desired to ignite the pilot burner, knob 44 is rotated to its "pilot" position, as shown, such that recess 46 is aligned with protrusion 48 on the casing to permit the knob and thus the shaft 36 to be manually depressed. As the shaft 36 moves inwardly of casing 10, shoulder 40 will engage arm 66 of lever 62 such that the lever will be rotated clockwise as can be seen in FIG. 2. The initial movement of the shaft 36 (i.e., approximately the first 75 percent of its full downward travel) causes lever 62, cting through arm 68, to move armature 54 into housing 52 almost to the point where the magnet poles thereof are seated against the magnet keeper within the housing. It is noted that as lever 62 is rotated from its counterclockwise position in FIG. 1 to that of FIG. 2, arm 68 moves away from the upper surface of lever 72 and, in view of the spaced relationship between arms 68 and 70, lever 72 becomes disengaged or freed from lever 62 and the force transmitted thereby from spring 56. Thus, in the position shown in FIG. 2, the forces acting upon lever 72 are the biasing force from torsion spring 76 (which tends to open valve 80) and the pressure differential across valve 80 (which tends to maintain the valve closed). It should be noted that in FIG. 2 walve 80 is shown in the closed position indicating that the force exerted by the gas pressure differential across valve 80 in this illustration is sufficient to overcome the opening force of torsion spring 76 thus maintaining valve 80 in this closed position. However, the gas pressure differential across valve 80 may not be sufficient to overcome the opening force of torsion spring 76, in which case the lever 72 would follow lever 62 in its clockwise rotation around pin 64 although none of the resetting force being applied to lever 62 would be transmitted to lever 72 at this time.

Referring to FIG. 3, as the knob 44 is depressed to its full extent, lever 62 is further rotated clockwise to fully reset armature 54 against the magnet keeper in housing 52. At this point, lever 62 will have been rotated sufficiently to bring arm 70 into engagement with the undersurface of lever 72 such that valve 80 is lifted slightly away from its seat. With the valve 80 slightly

opened, the gas pressure differential thereacross rapidly becomes balanced whereupon the only force acting upon lever 72 is the clockwise biasing force produced by torsion spring 76. Spring 76 thus acts to rotate lever 72 so as to swing valve 80 to its fully open position as shown in FIG. 4.

The fully open position of valve 80 is defined by the engagement of lever 72 with the undersurface of arm 68 of lever 62 such that the valve does not swing up against an interior wall of the casing 10.

With valve 80 open, gas from inlet 12 flows through passage 28, groove 30 in the wall of plug valve 24 and pilot flow passage 32 to the pilot burner (not shown) for ignition. Upon successful ignition of the pilot burner, the thermocouple sensor associated therewith will be heated so as to generate a thermoelectric voltage for the reset magnet in housing 52. This voltage causes the magnet to hold armature 54 in its withdrawn position shown in FIG. 4 whereupon levers 62 and 72 are maintained in the position shown in FIG. 4 when shaft 36 returns to its normal position after release of knob 44. Thereafter plug valve 24 may be rotated to its "on" position so as to bring bore 26 into registry with passage 28 for establishing a main flow to the main burner (not shown) of the system.

If, at any time, the magnet in housing 52 becomes deenergized due to pilot flame outage or any other cause, armature 54 will be released and spring 56 will cause the armature to move outwardly of the housing 52. As a result, both levers 62 and 72 will be rotated counterclockwise simultaneously to their "valve-closed" positions as shown in FIG. 1. The return of levers 62 and 72 to the positions illustrated in FIG. 1 winds-up torsion spring 76 and, as valve 80 becomes seated, reestablishes the gas pressure differential across valve 80 and cuts-off both the pilot and main burner flows to safely shut-down the system and preclude raw-fuel leakage.

The distinct advantages of the dual lever mechanism 60 according to the present invention can be readily appreciated in that lever 72, and thus valve 80, is only moved by shaft 36 during approximately the last 25 percent of movement thereof with such movement of lever 72 designed only to slightly lift valve 80 away from its seat thereby enabling balancing of the pressure differential thereacross. In other words, the opening of valve 80 is primarily produced by the action of torsion spring 76, and the forces generated by manually moving knob 44 downwardly only act to slightly lift valve 80 from its seat to, in effect, release the valve for subsequent movement by spring 76. At this same time, the full force developed by the movement of shaft 36 is transmitted to armature 54 so as to assure positive resetting thereof. In this manner, the holding armature will be efficiently reset while any possible damage to the lever 72 or the valve 80 is avoided regardless of the amount of force applied through knob 44 and shaft 36 during the reset cycle.

Referring now to FIGS. 5 and 6, a method of calibrating the dual lever mechanism 60 of the subject invention is schematically illustrated such that compensation for variations in production tolerances may be readily made. As shown in FIG. 5 one of levers 62 and 72 is bent so as to limit or decrease the amount of lost motion therebetween, with arm 70 of lever 62 shown in a typical bent or pre-calibrated position for illustrative purposes only. With arm 70 bent, as shown, knob 44 is depressed and held so as to bring the dual lever mechanism 60 to the position illustrated. With knob 44 maintained fully depressed, a calibration member 82 is inserted though inlet port 12 and the end thereof brought into engagement with the distal end of lever 72 as shown in FIG. 6. A force is then exerted through the calibration member to bring valve 80 closed, thus bending arm 70 to its proper calibrated position. It should be understood that the small amount of spring-back of arm 70 will be sufficient to slightly lift the valve 80 away from its seat to the position illustrated in FIG. 3 during subsequent normal operation. The amount of valve opening due to the spring-back of arm 70 will primarily determine how much the valve is opened by lever 62 during the reset cycle.

A modification of the dual lever mechanism of FIGS. 1–4 is illustrated in FIGS. 7–9, it being understood that such mechanism is adapted for use in various different applications and, in particular, may be effectively utilized in the combination control device described and illustrated above with respect to FIGS. 1–4. For purposes of clarity, parts in FIGS. 7–9 which are similar to parts in FIGS. 1–4 will be identified by identical reference numerals with one hundred (100) added thereto.

The dual lever mechanism of FIGS. 7–9 includes a first lever 162 which is formed from a flat plate bent to provide a generally U-shaped configuration with a pair of side walls 184 and 186 interconnected by a rear wall 188. A first arm 166 projects upwardly from the approximate center of the upper edge of rear wall 188. A lower central portion of wall 188 is deformed out of the plane of wall 188 to provide a slightly inclined offset second arm or operating surface 168 for lever 162, with the undisturbed lower edges of wall 188 providing a third arm or operating surface 170 as can be seen in FIG. 7. Each of the side walls 184 and 186 of lever 162 defines an aperture 185 and 187, respectively, to accommodate a pivot pin 164 which may be press-fit therein, if desired, for retaining the assembly.

A second lever 172 having a generally U-shaped cross-section for structural rigidity is also rotatably mounted on pin 164 by a pair of upstanding, journaled tabs 174 formed on one end thereof. As can be seen in FIGS. 8 and 9, the width of lever 172 is slightly less than that of lever 162 such that lever 172 may be freely accommodated between walls 184 and 186. The floor of lever 172 at its pivoted end defines a cut-out or void 190, with the floor of the lever adjacent each side of void 190 slit longitudinally and bent down to form a pair of arcuate tabs 192. Protruding from the floor of lever 172 into the throat of void 190 is an upwardly curved tongue 194 which is longitudinally crimped, as illustrated, for rigidification. Levers 162 and 172 are assembled on pin 164 such that tongue 194 and tabs 192 cooperate with the rear surface of arm or operating surface 168 and the lower edge of wall 188, respectively, to define the limits of rotation between the two levers. A torsion spring 176 is coiled about pin 164 and has a first end disposed in an aperture 196 in lever 172 and a second end which is adapted to engage protrusion or stop member 78 (see FIG. 1) of casing 10.

The operation of the dual lever mechanism of FIGS. 7–9 is substantially identical to that of the embodiment of FIGS. 1–4 and thus will not be described again in detail for the sake of brevity. It is noted, however, that the dual lever mechanism of FIGS. 7–9 is adapted to be mounted in casing 10 in the same relative position as

mechanism **60**, with arm **166** of lever **162** adapted to be engaged by shoulder **40** of shaft **36** and with arm or operating surface **168** engaging armature **54**. As illustrated in FIG. **8**, the undersurface of arm **168** of lever **162** engages tongue **194** of lever **172** when the mechanism is in its "valve closed" position corresponding to that illustrated in FIG. **1**, and, as shown in FIG. **9**, arm or surface **170** of lever **162** engages tabs **192** of lever **172** when the mechanism is in a position corresponding to that illustrated in FIG. **3**.

The lever mechanism of FIGS. **7–9** may be calibrated in the same manner as is shown in FIGS. **5** and **6** with the exception that tabs **192** of lever **172** initially will be bent outwardly beyond their normal positions such that as lever **162** is held in its clockwise position by shoulder **40** of depressed shaft **36** and lever **172** is forced so as to close valve **180** by means of calibration member **82**, the tabs will be bent back to their desired positions.

Thus, it can be seen that the present invention provides a simple, inexepnsive and reliable apparatus for enabling the sequential operation of two loads, namely a holding magnet and a safety valve member, by a common operator such that any excessive force which might be applied to the operator is isolated from damaging the safety valve member or the lever upon which it is carried. Furthermore, the present invention is readily adaptable for use with many conventional control devices which presently utilize only a single lever mechanism thus enabling simple modification of such controls so as to increase their safety characteristics while at the same time reducing maintenance and repair cost.

Inasmuch as the present invention is subject to many variations, modifications and changes in detail, it is intended that all matter contained in the foregoing description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A dual lever mechanism comprising in combination

a first movable load,

a second movable load,

a movable operator,

first lever means cooperating with said first load and said operator to transmit substantially full movement of said operator to said first load for full movement thereof, and

second lever means cooperating with said first lever means and said second load to transmit only a terminal portion of the movement of said first lever means to said second load for partial movement thereof.

2. The invention as recited in claim **2** wherein said first and second lever means are rotatable about a common axis.

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