

[54] **SAFETY CONTROL VALVE FOR PROPANE CATALYTIC HEATER**

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[58] Field of Search..... 137/65, 66, 209;
431/79, 80, 53; 251/207, 297, 208, 206

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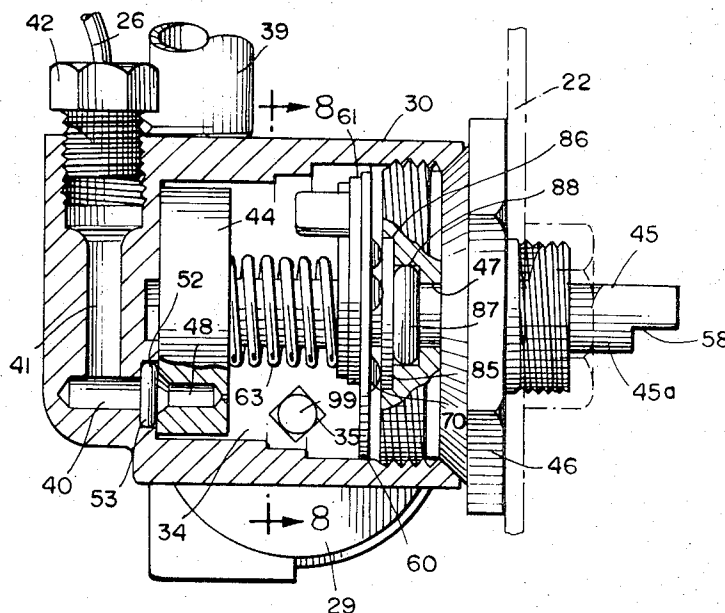
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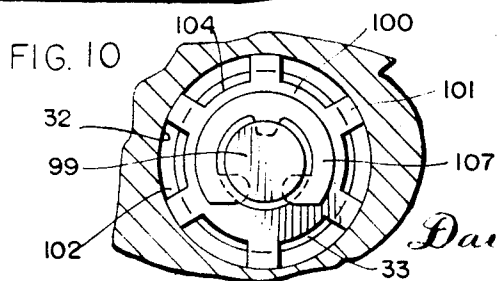
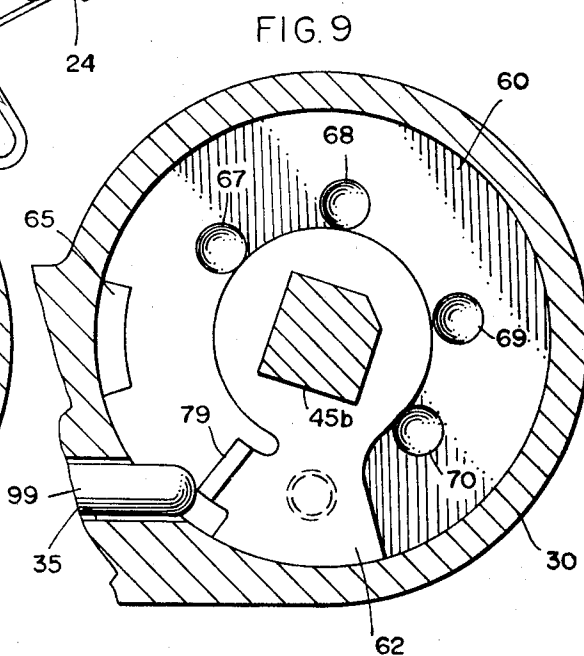
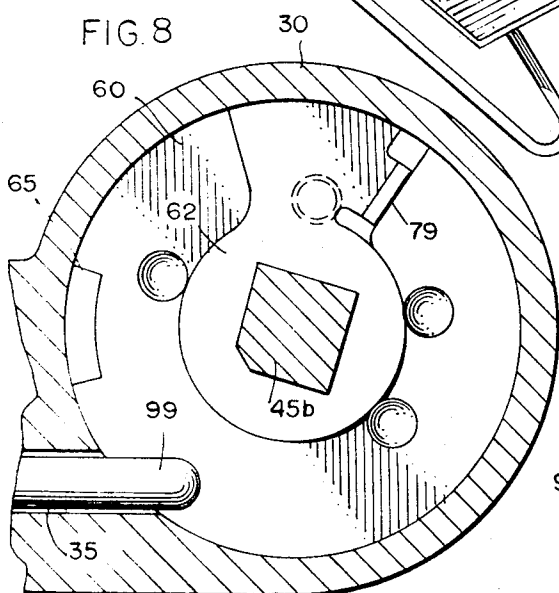
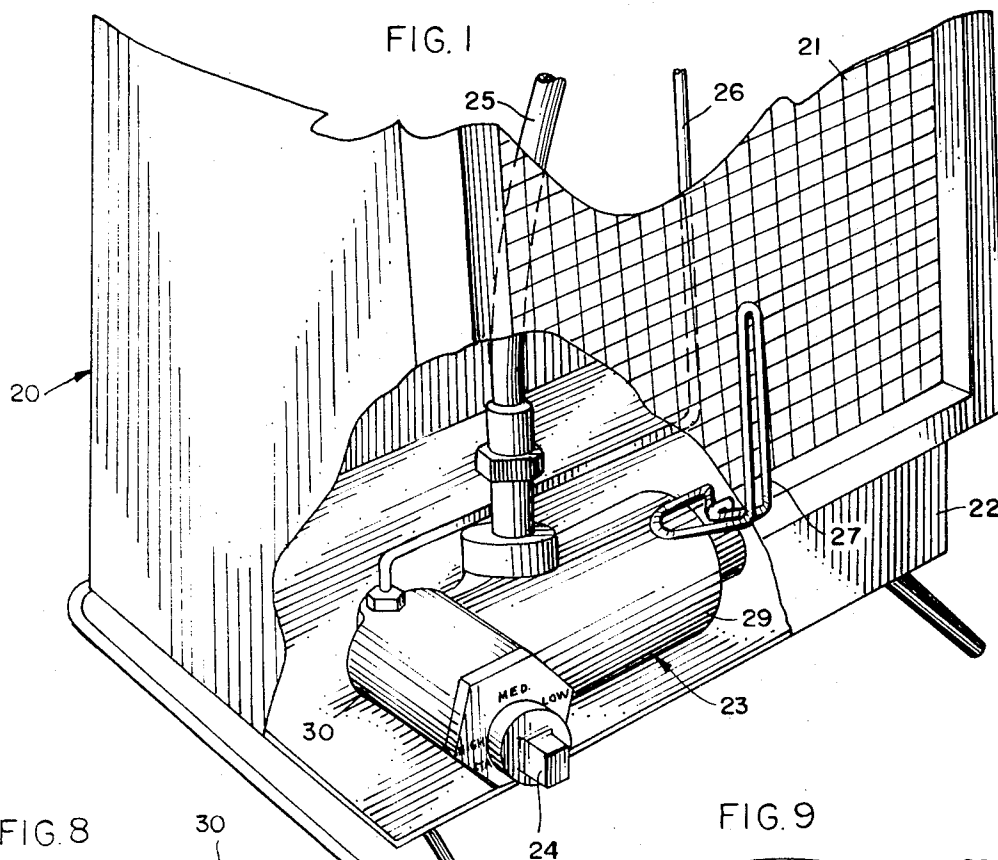
[57] **ABSTRACT**

A safety control valve for propane catalytic heaters is provided which meters a desired amount of fuel to the

catalytic heater head when the heater is operating but which prevents fuel flow when the heater is not operating. The valve includes a casing in which a control shaft is rotatably mounted, the casing having a fuel inlet port and a fuel outlet port. An orifice plate is mounted on the shaft for rotation adjacent the outlet port and is provided with a plurality of different sized openings which are registrable with the fuel outlet port to regulate the amount of fuel being supplied to the heater. The shaft extends rotatably through a plate provided with position-indicating pockets which successively receive a ball bearing positioned within an opening in another plate which rotates with the shaft. The bearing is resiliently biased toward the position-indicating pockets by a presser plate which also includes an axially extending tang. The fuel inlet port is provided by a bore extending generally perpendicularly to the shaft, and a rod is slidably mounted within the bore and resiliently biased toward the shaft. A valve closure member is resiliently biased against a valve seat surrounding the inlet bore to close the bore, and when the shaft is rotated to the start position the tang engages the rod and pushes it against the valve closure member to open the inlet port. An electromagnetic power head is operatively connected to the valve closure member for holding the closure member in an open position when the catalytic heater is operating.

9 Claims, 14 Drawing Figures

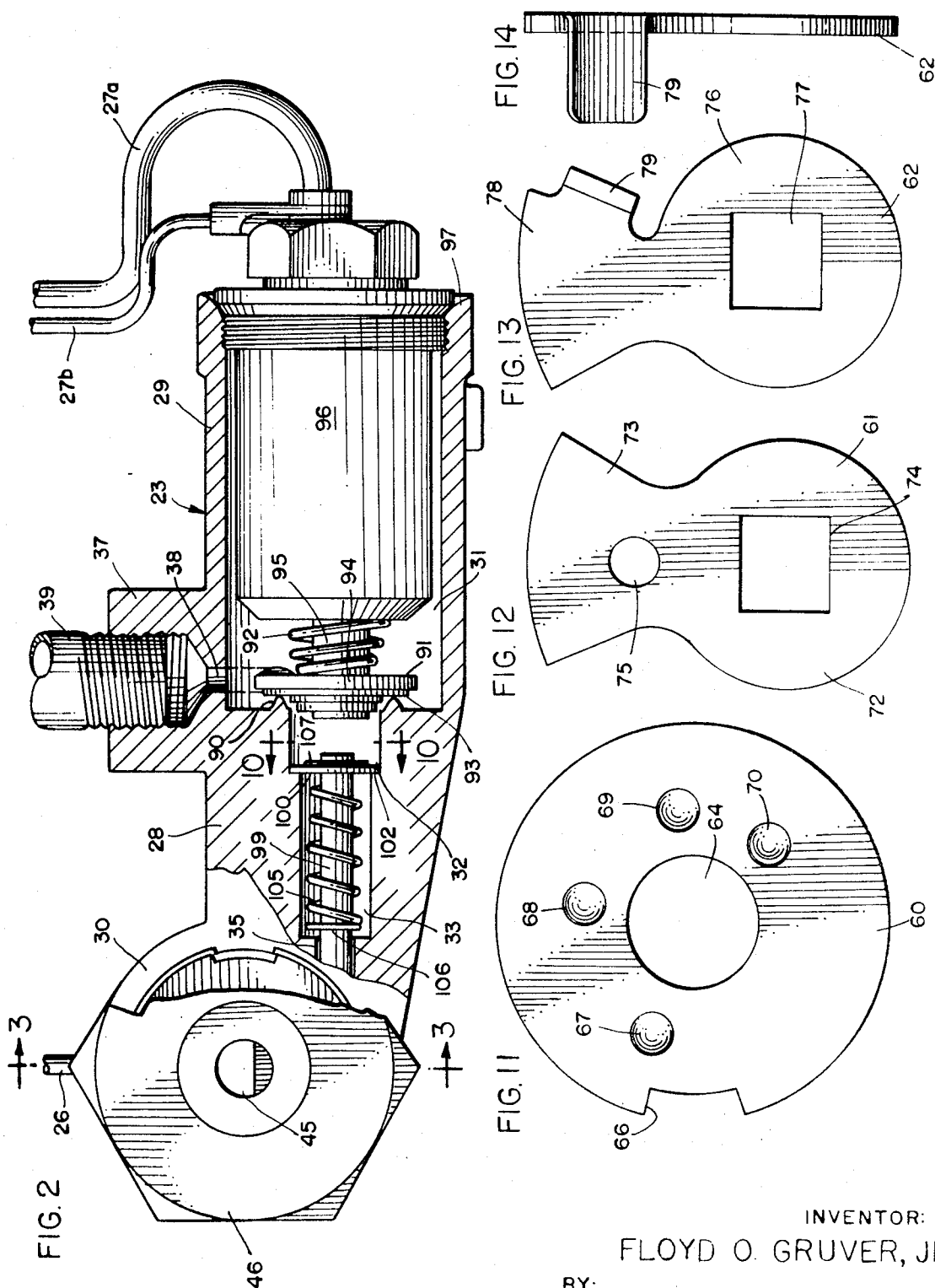




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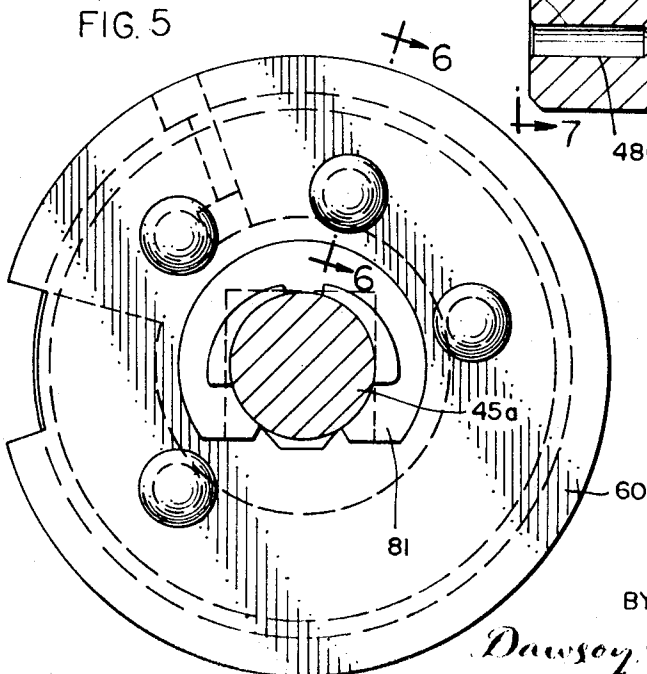
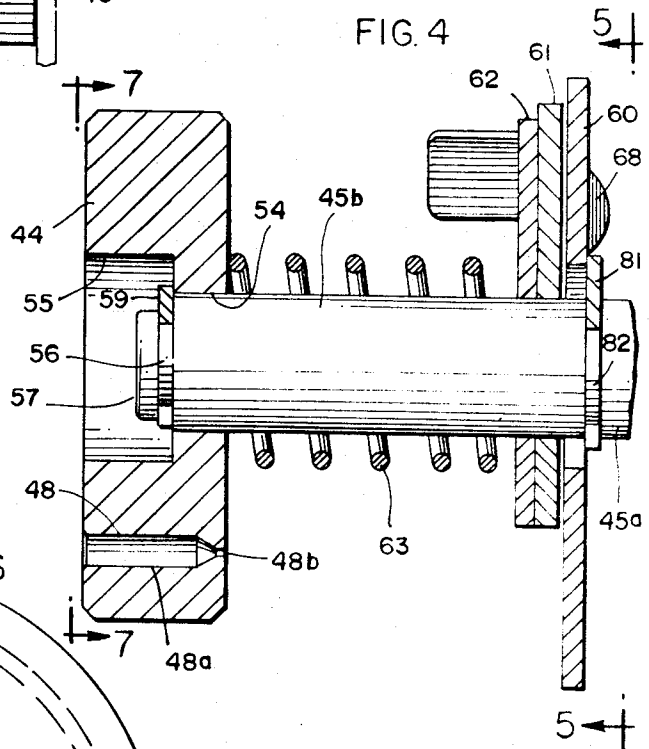
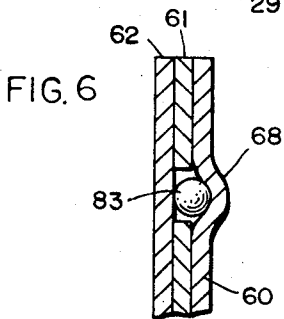
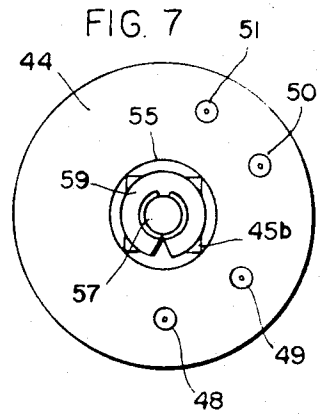
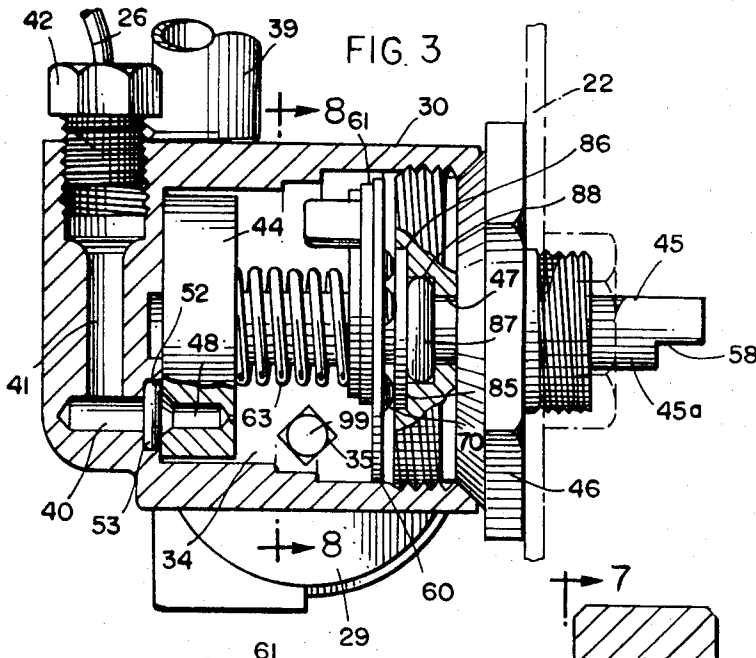
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SAFETY CONTROL VALVE FOR PROPANE CATALYTIC HEATER

BACKGROUND

This invention relates to a safety control valve, and, more particularly, to a safety control valve for use with propane catalytic heaters.

Catalytic heaters which are fueled by liquid fuel such as white gasoline are well known. These heaters include a catalytic combustion head which encloses a fuel vapor collection space to which the liquid fuel is supplied by a capillary action wick. The fuel is evaporated from the wick by the heat of the combustion head, and when the combustion on the combustion head is extinguished, the rate of evaporation of the liquid fuel is reduced to an insignificant, safe level.

Catalytic heaters which are fueled by propane present different problems. The propane is generally supplied in pressurized cylinders containing gas and liquefied propane. Since the propane gas is supplied to the heater under pressure, it is desirable that some means be provided for shutting off the supply of gas if the heater is not operating. Also, it is desirable to provide some means for metering the amount of fuel being supplied to the heater so that the heat output of the heater can be varied as desired.

SUMMARY

The invention provides a safety control valve which both meters a desired amount of fuel and performs a safety function by shutting off the fuel flow when the heater stops operating. The safety shut-off valve can be manually opened when the heater is to be started to permit fuel to flow to the heater, and the valve will return to a closed position when the manual force is released if the heater has not been started. The safety shut-off valve is operatively connected to an electromagnetic power head which is operated by a thermocouple, and when the thermocouple is heated sufficiently by the heater, the safety shut-off will be retained in an open position by the power head. If combustion on the catalytic combustion head is extinguished, the thermocouple will cool, and the power head will then permit the safety shut-off to close to stop the flow of fuel. The same operating shaft which opens the safety shut-off also carries an orifice plate for metering the gas being supplied to the combustion head. The orifice plate is provided with a plurality of different sized orifices, each of which will meter the fuel flow at a different rate. Position-indicating means are also carried by the shaft for indicating when each orifice is properly positioned for gas flow.

DESCRIPTION OF THE DRAWING

The invention will be explained in conjunction with an illustrative embodiment shown in the accompanying drawing in which

FIG. 1 is a fragmentary perspective view, partially broken away, of a propane catalytic heater equipped with the inventive safety control valve;

FIG. 2 is a front elevational view, partially broken away, of the valve;

FIG. 3 is a sectional view taken along the line 3—3 of FIG. 2;

FIG. 4 is an enlarged view of a portion of FIG. 3;

FIG. 5 is an end view taken along the line 5—5 of FIG. 4;

FIG. 6 is a fragmentary sectional view taken along the line 6—6 of FIG. 5;

FIG. 7 is an end view, in reduced scale, taken along the line 7—7 of FIG. 4;

FIG. 8 is a sectional view taken along the line 8—8 of FIG. 3;

FIG. 9 is a view similar to FIG. 8 showing the control shaft rotated to the starting position;

FIG. 10 is a fragmentary sectional view taken along the line 10—10 of FIG. 2;

FIG. 11 is a plan view of the position-indicating plate;

FIG. 12 is a plan view of the intermediate plate;

FIG. 13 is a plan view of the presser plate; and

FIG. 14 is a side view of the presser plate of FIG. 13.

DESCRIPTION OF SPECIFIC EMBODIMENT

Referring now to FIG. 1, the numeral 20 designates generally a catalytic heater designed for use with pressurized cylinders of liquefied propane. The heater includes a catalytic combustion head 21 mounted in an outer casing 22 and a fuel control valve 23.

The fuel control valve is mounted within the casing 22 and may be operated by a control knob 24 on the outside of the casing which can be used to switch the control valve to a variety of positions, for example, low, medium, high and start. The control valve is supplied with fuel through a fuel hose 25 which is connected to a suitable source of L.P. gas, such as a conventional throw-away cylinder, and the valve supplies fuel to the combustion head through a tube 26. The thermocouple 27 is operatively connected to the control valve and extends upwardly in front of the combustion heater for sensing the operation of the heater.

Referring now to FIGS. 2 and 3, the safety control valve is seen to have a generally L-shaped body or casing 28 which includes an elongated generally cylindrical safety portion 29 and a generally cylindrical control portion 30 extending generally perpendicularly from the safety portion. The safety portion includes a central main bore 31, and a pair of radially reduced bores 32 and 33 which extend axially toward the control portion of the valve. The control portion also includes a central bore 34, and the central bore 34 and the bore 33 communicate through an inlet bore 35 having a generally rectangular cross section.

The safety portion of the casing includes an upwardly extending internally threaded coupler projection 37, and a fuel passage 38 extends through the coupler projection to the main bore 31. A coupling fitting 39 is threadedly engaged with the projection 37 and serves to connect the fuel supply hose 25 to the valve. As will be explained in detail hereinafter, when the valve is in an open position, fuel can flow through the hose 25 and the fuel passage 38 into the main central bore 31 of the safety portion of the valve and then through the bores 32, 33, and 35 into the central bore 34 of the control portion of the valve. The fuel then flows through a first outlet bore 40 which extends parallel to the axis of the bore 34 but which is offset therefrom and a second outlet bore 41 which extends generally vertically upwardly. The upper end of the outlet bore 41 is internally threaded for engagement with a coupling fitting 42 connected to the fuel supply tube 26.

The amount of fuel flowing from the bore 34 of the control portion to the outlet bore 40 is metered by a circular orifice plate 44 which is mounted for rotation on an elongated control shaft 45. The bore 34 is closed

by a cap 46 which is threadedly engaged with internal threads within the bore, and the cap includes a central bore 47 of circular cross section. The operating shaft 45 includes a generally cylindrical portion 45a which has a diameter slightly less than the diameter of the bore 47 and which is rotatably supported therein and a generally rectangular portion 45b (FIG. 8).

As can be seen best in FIGS. 4 and 7, the orifice plate 44 is provided with four openings 48, 49, 50 and 51 which are disposed arcuately around the center of the plate. The opening 48 is seen to include a major portion 48a of relatively constant diameter which extends through most of the thickness of the orifice plate and terminates in an orifice 48b sized to permit a desired amount of gas flow therethrough. The other openings 49 and 50 may include similarly sized major portions, but each of the openings terminates in a different size orifice to provide varying rates of gas flow depending upon which opening is aligned with the outlet bore 40. An annular enlargement 52 is provided around the outlet opening and receives a resilient and compressible O-ring 53 which sealingly engages the orifice plate.

The orifice plate is provided with a generally rectangular central opening 54 which receives the square portion 45b of the control shaft and an enlarged circular counterbore 55. The rear end of the control shaft which is inserted through the orifice plate terminates in an annular groove 56 and an end cap portion 57, and the shaft is retained within the orifice plate by means of an E-ring 59 which is positioned in the annular groove.

The forward end of the shaft 45 extends through the cap 46 and is provided with a notch 58. The control knob 24 is received on the outer end of the shaft, and the knob and the shaft are locked against relative rotation by the notched end 58 which cooperates with a correspondingly shaped bore in the knob. The amount of fuel which flows from the bore 34 through the outlet bore 40 can therefore be varied by turning the knob to the orifice plate opening of the desired size with the O-ring 53.

Means for indicating the position of the openings in the orifice plate are provided in the form of three plates 60, 61 and 62, and a coil spring 63. The position-indicating plate 60 is generally circular and has an outside diameter approximately the same as the inside diameter of the bore 34. The plate is provided with a central opening 64 large enough to permit rotation of the square portion 45b of the shaft therewithin, the plate being secured against rotation by an abutment 65 (FIG. 8) which extends inwardly from the wall of the casing and is received in a correspondingly shaped notch 66 in the plate. Four generally hemispherical pockets or embossments 67, 68, 69 and 70 are formed in the plate 60 and open toward the orifice plate 44.

The intermediate plate 61 includes a generally circular portion 72 (FIG. 12) and a radially outwardly extending tongue portion 73. The circular portion is provided with a generally rectangular central opening 74 sized to receive the square shaft portion 45b, and the tongue portion is provided with a circular opening 75 spaced from the center of the opening 74 a distance substantially the same as the radius of the arc along which the pockets 67-70 are disposed.

The presser plate 62 has a shape similar to the shape of the intermediate plate and includes a circular portion 76 provided with a square opening 77 and an out-

wardly extending tongue portion 78. A tang or tab 79 extends from the tongue portion 78 generally perpendicularly to the plane of the plate.

The position-indicating plate 60 is retained on the square shaft portion by an E-ring 81 which is received in an annular groove 82 between the rectangular shaft portion 45b and the circular shaft portion 45a. The presser plate 62 and the intermediate plate 61 are resiliently biased against the position-indicating plate by the coil spring 63, and a ball bearing 83 (FIG. 6) is positioned in the opening 75 in the intermediate plate 61. The diameter of the ball bearing is greater than the thickness of the intermediate plate, and the ball bearing is therefore urged against the plate 60 by the presser plate 62. As the plates 61 and 62 rotate with the shaft relative to the position-indicating plate 60, the ball bearing is moved arcuately along the surface of the plate 60 until it reaches one of the pockets 67-70. The ball bearing is then forced into the pocket, providing both an audible click and a restraining force against further rotation which can be felt by the operator turning the knob. The pockets 68-70 are located relative to the openings 48-50 in the orifice plate to permit the ball to be received in one of the pockets each time one of the openings in the orifice plate is aligned with the O-ring 53.

The fourth pocket 67 is for indicating the off position, and when the ball is received in this pocket, an imperforate portion of the orifice plate engages the O-ring 53 to seal the outlet opening.

The fourth opening 51 in the orifice plate is aligned with the O-ring 53 when the control shaft 45 is turned to the start position as will be explained more fully hereinafter, and the alignment of this opening with the O-ring need not be indicated by the indicating means.

Since the pockets are generally hemispherical in shape, the ball can be cammed out of a pocket by applying a torque on the shaft sufficient to overcome the bias of the spring 63 which acts on the ball.

The embossments 67-70 in the position-indicating plate 60 engage a washer 85 (FIG. 3) which is received in an annular groove 86, and the washer in turn engages a compressible and resilient O-ring 87 which is positioned in annular groove 88. The spring 63 presses the washer 85 into engagement with the O-ring 87 to compress the O-ring into sealing engagement with the shaft 45 and the casing and also presses the orifice plate 44 into sealing engagement with the O-ring 53.

The control portion of the valve will be explained with reference to FIG. 2. The interior of the casing 28 includes a circular rim or valve seat 90 which extends axially with respect to the fuel inlet bore 32. A valve closure member 91 is resiliently biased against the valve seat by a helical coil spring 92, and the particular valve closure member illustrated includes a compressible and resilient rubber disc 93 and a relatively rigid backup disc 94. The valve closure member is carried by a shaft 95 which extends into an electromagnetic power head 96 which is threadedly received by the open end 97 of the casing.

The two wires 27a and 27b which form the thermocouple 27 are connected to the power head 96 for supplying current thereto. The power head is conventional and a detailed description thereof is believed unnecessary. One particular power head that has been used is available from General Controls of Glendale, Calif. The electromagnetic means of the power head is se-

lected to hold the shaft 95 in an open position in which the valve closure member is spaced from the valve seat 90 when a predetermined amount of current is supplied to the power head by the thermocouple by virtue of the heat output from the catalytic combustion head and to release the shaft when the current drops below a certain minimum.

Means for manually moving the valve closure member to an open position is provided in the form of an elongated rod 99 which is slidably received in the bores 33 and 35 of the casing. The rod is generally circular in cross section and is sized to be slidably supported by the square bore 35 (FIG. 3), and the other end of the rod is slidably received by a central opening in a lock washer 100 (FIG. 10). The lock washer 100 includes a plurality of radially extending projections 101 which frictionally engage the wall of the bore 32, and the washer is press fitted against the shoulder 102 which joins the bores 32 and 33. The diameter of the circular outer periphery 104 of the washer is less than the diameter of the bore 33 to permit gas to flow between the projections 101 into the bore 33.

A return spring 105 is carried by the rod 99 between the washer 100 and an abutment 106, which can be conveniently provided by an E-ring received by an annular groove in the rod. The return spring 105 resiliently biases the rod to the left as viewed in FIG. 2 away from the valve closure member 94, and a stop member 107, which may also be an E-ring received by an annular groove adjacent the end of the rod, is positioned outwardly of the washer 100.

Referring to FIGS. 8 and 9, the end 79a of the rod 99 is rounded and extends through the bore 35 into the bore 34 a sufficient distance to be engaged by the tang 79 on the presser plate 62 when the shaft 45 is rotated clockwise. The tang is inclined at about 45° from the axis of the rod when the rod is contacted, and the inclined surface of the tang presses the rod toward the valve closure member 91 to unseat the valve closure member from the valve seat. When the shaft has been rotated to open the valve 90, the orifice 51 in the orifice plate will have been rotated into alignment with the O-ring 53 and the outlet bore 40. Fuel will thereby be permitted to flow from the fuel hose 25 through the fuel tube 26 to the combustion head.

When sufficient fuel has been supplied to the combustion head, the heater can be ignited. The control shaft is manually held in the start position until the thermocouple is heated sufficiently to provide enough current to the power head to magnetically hold the valve closure member away from the valve seat. If the control knob is released before this minimum amount of current is supplied to the power head, the spring 92 will return the valve closure member to the valve seat to shut off the flow of fuel. The spring 105 which is ensleeved on the rod 99 will also return the rod to its original position and rotate the shaft counterclockwise as viewed in FIG. 9. It is advantageous to position the position-indicating pocket 70 relative to the rod 99 so that the ball bearing 83 is positioned in the pocket 70 by the return of the rod. The high fuel flow opening 50 through the orifice plate will then be aligned with the outlet bore 40, but fuel flow will be stopped by the valve closure member 91.

If the thermocouple is heated sufficiently before the control shaft is released from the start position, the power head will retain the valve closure member in an

open position, and the rod 59 will rotate the shaft to the high fuel flow position in which the ball bearing is positioned in the pocket 70. The operator can then leave the control shaft in the high fuel flow position or rotate the shaft to the medium or low position.

If for some reason combustion on the combustion head is extinguished, the thermocouple will cool, and the current being supplied to the power head will eventually fall below the minimum required to hold the valve closure member open. The valve closure member will therefore return to the closed position, and the flow of fuel will be shut off before a dangerous amount of gas can accumulate.

If the control shaft is manually turned to the off position, the orifice plate will immediately block fuel flow to the outlet bore 40, and the heater will be extinguished. As the thermocouple cools, the valve closure element will also return to the closed position. Accordingly, even if the control shaft is later rotated away from the off position, fuel will not flow.

Although the openings 48-50 in the orifice plate are sized to provide low, medium, and high fuel flow, respectively, the opening 51, through which fuel flows when the control shaft is in the start position, can be the same size as one of the other openings or can be larger if even more fuel flow is desired to start the heater.

While in the foregoing specification, a detailed description of a specific embodiment of the invention was set forth for the purpose of illustration, it is to be understood that many of the details herein given may be varied considerably by those skilled in the art without departing from the spirit and the scope of the invention.

I claim:

1. A fuel control valve comprising a casing having a fuel inlet port and a fuel outlet port, a shaft rotatably mounted within the casing, an orifice plate mounted on the shaft for rotation therewith adjacent the fuel outlet port, the orifice plate being provided with a plurality of different sized openings therethrough, each opening being alignable with the fuel outlet port as the shaft rotates, a position-indicating plate extending generally parallel with the orifice plate and having a central opening therethrough rotatably receiving the shaft, the position-indicating plate being secured against rotation with the shaft by the casing and being provided with a plurality of ball-receiving pockets therein disposed arcuately around the shaft, an intermediate plate mounted on the shaft for rotation therewith between the orifice plate and the position-indicating plate, the intermediate plate having an opening therethrough spaced from the shaft about the same distance as the ball-receiving pockets, a ball positioned in the opening in the intermediate plate, and having a diameter greater than the thickness of the intermediate plate, a presser plate mounted on the shaft between the intermediate plate and the orifice plate, a coiled spring ensleeved on the shaft between the orifice plate and the presser plate and biasing the presser plate toward the intermediate plate to force the ball against the position-indicating plate and into the ball-receiving pockets as the intermediate plate rotates with respect to the position-indicating plate.

2. The fuel control valve of claim 1 in which the casing is provided with a main bore in which the shaft and the plates mounted thereon rotate and an inlet bore extending generally perpendicularly to the axis of the

main bore, a rod slidably mounted within the inlet bore, a spring biasing the rod toward the main bore, a valve seat surrounding the inlet bore, a valve closure member resiliently biased against the valve seat for closing the inlet bore, and abutment means on one of the plates which rotates with the shaft, the abutment means being engageable with the rod as the shaft rotates for moving the rod against the valve closure member to force the valve closure member away from the valve seat.

3. The fuel control valve of claim 2 including electromagnetic means operatively connected to the valve closure member for holding the valve closure member away from the valve seat when a predetermined minimum electric current is supplied thereto and for releasing the valve closure member when sufficient electric current is not supplied thereto.

4. The fuel control valve of claim 2 in which the abutment means comprises a tang extending generally perpendicularly from the presser plate away from the intermediate plate.

5. A fuel control valve for a heater comprising a casing having fuel inlet and fuel outlet means, a shaft rotatably mounted within the casing, a plate mounted on the shaft for rotation therewith adjacent the fuel outlet means, the plate being provided with a plurality of different sized openings therethrough, each opening being alignable with the fuel outlet means as the shaft rotates, valve means for opening and closing the fuel inlet means, electromagnetic means for maintaining the valve open when the heater is operating, a second plate mounted on the shaft for rotation therewith, the second plate including abutment means, a rod slidably mounted within the casing for axial sliding movement toward and away from the valve means, the abutment means being rotatable into engagement with the rod as the shaft rotates to push the rod against the valve means to open the valve means, a third plate having a central opening receiving the shaft, the third plate being provided with a plurality of arcuately disposed ball-receiving pockets therein, and a ball yieldably biased against the third plate whereby the ball is forced successively into and out of the pockets as the ball travels arcuately over the third plate to provide position-indicating means.

6. The fuel control valve of claim 5 including a fourth plate mounted on the shaft between the second and third plates, the ball being positioned within an opening in the fourth plate and having a diameter greater than the thickness of the fourth plate, the third plate being secured against rotation by the casing, and spring means on the shaft biasing the second plate toward the fourth plate for urging the ball against the third plate.

7. A fuel control valve for a heater comprising a cas-

ing having a fuel inlet and fuel outlet means, a shaft rotatably mounted within the casing, a first plate mounted on the shaft for rotation therewith adjacent the fuel outlet means, the first plate being provided with a plurality of different sized openings therethrough, each opening being alignable with the fuel outlet means as the shaft rotates, second and third plates, each of the second and third plates having a central opening receiving the shaft, the second plate being provided with a plurality of arcuately disposed pockets therein opening toward the third plate, one of the second and third plates being rotatable with the shaft and the other of the second and third plates being secured against rotation with the shaft, spring means within the casing for yieldably biasing the second and third plates together, and ball means positioned between the second and third plates and being yieldably biased against the second plate, the ball means being receivable in the pockets as the second and third plates rotate relative to each other.

8. A fuel control valve for a heater comprising a casing having a fuel inlet and fuel outlet means, a shaft rotatably mounted within the casing, a first plate mounted on the shaft for rotation therewith adjacent the fuel outlet means, the first plate being provided with a plurality of different sized openings therethrough, each opening being alignable with the fuel outlet means as the shaft rotates, second and third plates, each of the second and third plates having a central opening receiving the shaft, the second plate being provided with a plurality of arcuately disposed pockets therein opening toward the third plate, one of the second and third plates being rotatable with the shaft and the other of the second and third plates being secured against rotation with the shaft, a fourth plate mounted on the shaft for rotation therewith between the second and third plates and having an opening therethrough spaced from the shaft about the same distance as the pockets of the second plate, and a ball bearing positioned within the opening in the fourth plate and between the second and third plates and having a diameter greater than the thickness of the fourth plate, the ball bearing being yieldably biased against the second plate and being receivable in the pockets of the second plate as the second and third plates rotate relative to each other.

9. The fuel control valve of claim 8 in which the ball bearing is yieldably biased against the second plate by a coil spring ensleeved on the shaft between the first plate and the second or third plate which is closest to the first plate.

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