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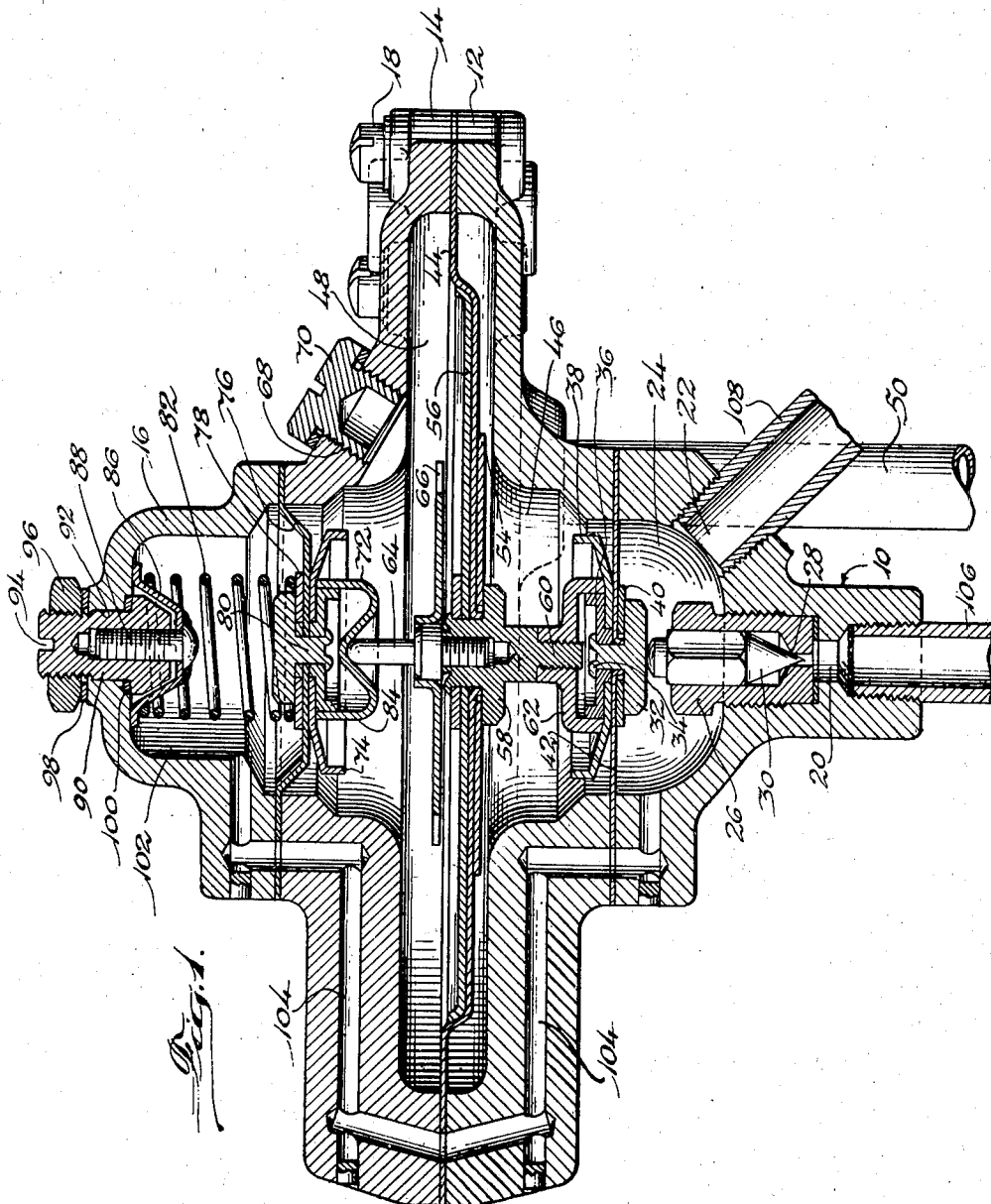
J. H. LESLIE, 2D

2,446,051

CONTROL VALVE

Filed Dec. 3, 1943

2 Sheets-Sheet 1



Inventor:
John H. Leslie II.
By *William A. Bradbury & Hinkle*
Attorneys.

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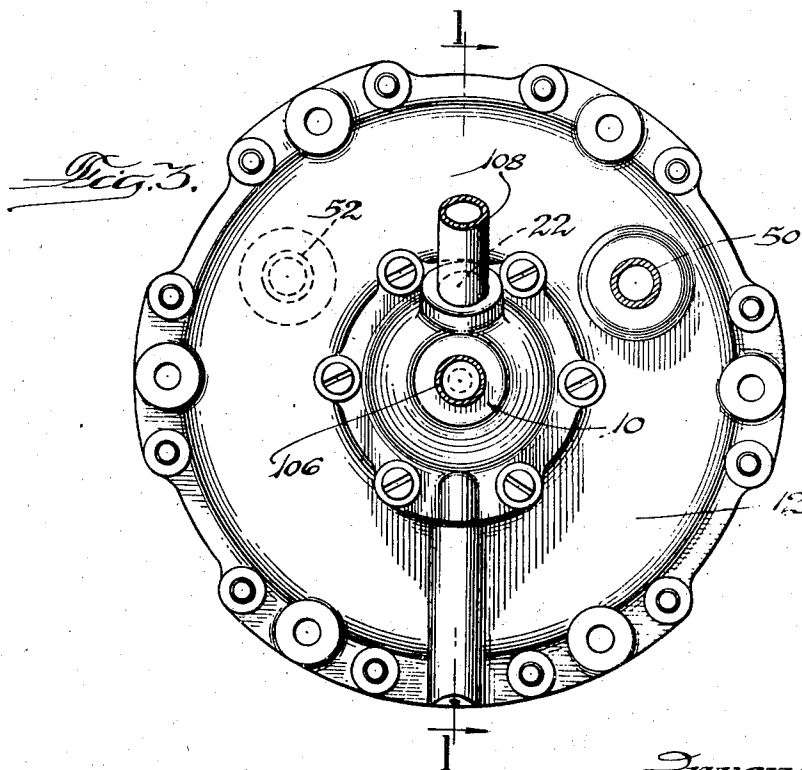
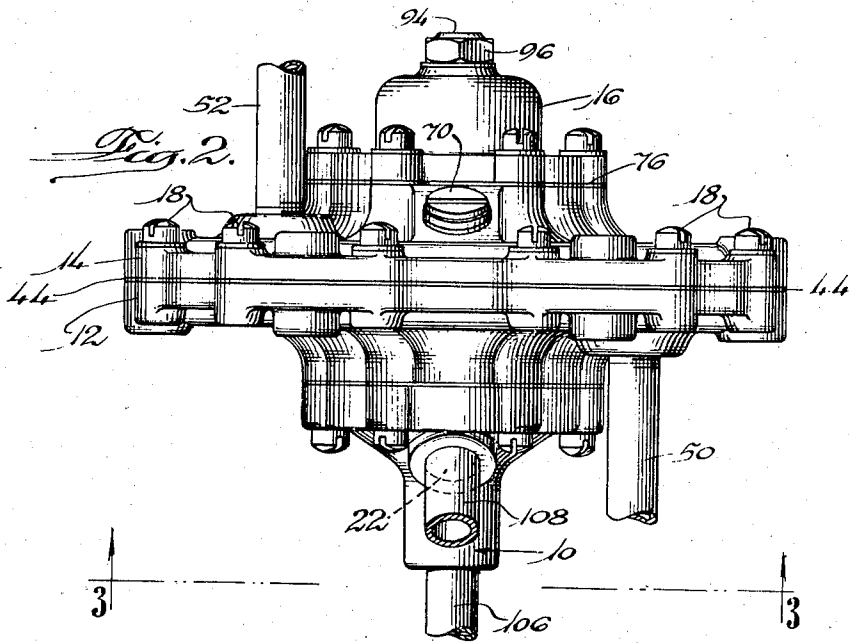
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2 Sheets-Sheet 2



Inventor:
John H. Leslie II.
By *Williams, Bradbury & Smith*
attorneys.

UNITED STATES PATENT OFFICE

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CONTROL VALVE

John H. Leslie, II, Winnetka, Ill., assignor to
Stewart-Warner Corporation, Chicago, Ill., a
corporation of Virginia

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9 Claims. (Cl. 137-153)

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My invention relates to control valves and more particularly to control valves especially adapted for supplying the fuel needs of internal combustion heaters of the kind commonly used on airplanes and other vehicles.

An object of my invention is to provide a new and improved control valve which accurately controls the fuel supply in accordance with the needs of an internal combustion heater.

Another object of my invention is to provide a new and improved control valve which is of simple construction, inexpensive to manufacture, and capable of affording long and trouble-free service.

Another object of my invention is to provide a new and improved control valve which may be connected to an internal combustion heater in any one of several ways whereby the control valve adapts itself more readily to various types of heater installations.

Another object of my invention is to provide a new and improved control valve which is equally adapted for use with an internal combustion heater having a nozzle for injecting the liquid fuel directly into the combustion chamber of the heater or with a heater wherein the fuel is mixed with combustion air prior to induction into the combustion chamber.

Another object of my invention is to provide a new and improved control valve which may be readily adjusted to afford any desired operating characteristics.

Another object of my invention is to provide a new and improved control valve which is capable of application to a wide variety of uses.

Other objects and advantages will become apparent as the description proceeds.

In the drawings:

Fig. 1 is a vertical, sectional view of a preferred form of control valve embodying my invention and is taken on the line 1-1 of Fig. 3;

Fig. 2 is a side elevation of the control valve of Fig. 1; and

Fig. 3 is a bottom view taken on the line 3-3 of Fig. 2.

That embodiment of my invention which I have illustrated in the drawings comprises a base casting 10, a pair of intermediate castings 12 and 14, and an upper casting 16 secured together by screws 18 or in any other suitable manner. The base casting 10 provides a fuel inlet 20 and a fuel outlet 22 connected through a valve chamber 24. A nipple 26 is threaded into the casting 10 and provides a valve seat 28 adapted to be engaged by the conical lower end of a valve member 30. This

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valve member is reciprocally mounted in the nipple 26 and the largest portion of this valve member is preferably rectangular, as shown, to permit flow of fuel therepast.

The valve member 30 is moved upwardly by the difference in fuel pressure between the inlet 20 and outlet 22 and is urged towards closed position by the force exerted thereon by a pressure plate 32. The pressure plate 32 has a rivet-like extension 34 whose upper end is clamped over a disc 36. A tapered cup 38 and a second disc 40 are confined between the head of the pressure plate 32 and the disc 36 and the central portion of a flexible diaphragm 42 is clamped between the cup 38 and disc 40. The periphery of this diaphragm is clamped between base casting 10 and intermediate casting 12. The diaphragm may be of metal or of fabric coated or impregnated with synthetic rubber or other suitable material.

A second flexible diaphragm 44 has its periphery clamped between intermediate castings 12 and 14 and cooperates with these castings to form a variable lower chamber 46 and a variable upper chamber 48 on opposite sides of the diaphragm 44. A pipe 50 connects the lower chamber 46 with the ventilating air inlet of an internal combustion heater and a pipe 52 connects the upper chamber 48 with the ventilating air outlet so that the differential pressure across the diaphragm 44 reflects the ventilating air drop across the heater. The central portion of the diaphragm 44 is reinforced by discs 54 and 56 located on opposite sides thereof. These discs are attached to a hub 58 having a depending screw 60 carrying a foot 62 provided with a cylindrical lower end which presses against the base of the cup 38 and surrounds the disc 36 to maintain proper alignment of this disc with the hub 58.

The hub 58 has a threaded central bore therein which rotatably receives the threaded lower end of a pin 64 carrying an adjusting plate 66 whose outer edge is notched so that the plate and pin can be rotated by engaging the notched edge of the plate by a screw driver or other suitable tool, to thereby screw the pin 64 into or out of the hub 58. The casting 14 is provided with a hole 68 through which this adjusting tool may be inserted. This hole is normally closed by a plug 70.

The upper end of the pin 64 is rounded, as clearly shown in Fig. 1, and fits into a recess provided in the base of a sheet metal cup 72 whose upper end engages dished plate 74 forming a reinforcement for the central portion of a third diaphragm 76. A second reinforcement plate 78 is located on the opposite side of this diaphragm,

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and these plates are secured to the diaphragm by a rivet 80 having an enlarged head forming a guide for a light spring 82. The rivet 80 also secures in place a guide 84 located in the upper end of the cup 72 and maintaining this cup in axial alignment with the rivet 80.

The upper end of the spring 82 rests against a washer 86 welded or brazed to a screw 88 threaded into a rotatable plug 90 extending through an opening 92 in the upper casting 16. The upper end of the plug 90 is provided with a kerf 94 adapted to receive a screw driver whereby the plug may be rotated to move the screw 88 up or down and thereby decrease or increase tension on the spring 82. The washer 86 and screw 88 are held against rotation with the plug 90 by the frictional contact between the washer 86 and spring 82 or, if desired, any suitable pin or other means may be provided to prevent rotation of the washer 86 and screw 88. The adjusting plug 90 is locked in position by a nut 96, and washers 98 and 100 are provided to prevent leakage between the plug 90 and casting 16.

The chamber 102 formed above the upper diaphragm 76 is connected to the valve chamber 24 by a duct 104 extending through the several castings and appropriate openings in the diaphragms clamped between these castings. This conduit conducts fuel to the upper chamber 102 so that the control valve is balanced with respect to the fuel pressure in the valve chamber 24, provided the upper diaphragm 76 and lower diaphragm 42 have the same effective area and operating characteristics. Preferably, however, the upper small diaphragm 76 has different operating characteristics from the lower diaphragm 42, so that the operating characteristics of the control valve can be varied by adjusting the plate 66 to vary the distance between the central portions of the large diaphragm 44 and upper diaphragm 76.

As clearly shown in Fig. 1 of the drawings, the upper diaphragm 76 has a rolled edge which reduces the effective area of this diaphragm when the diaphragm is in the position shown or at least reduces the response of the diaphragm to downward pressure thereon. To increase the response of this diaphragm to downward pressure, it is only necessary to rotate the adjusting plate 66 in a direction to move the central portion of diaphragm 76 upwardly relative to the central portion of the main diaphragm. This changes the relationship between the forces due to fuel pressure and the forces due to differential air pressure across the large diaphragm 44 and thereby varies the fuel delivery for any given pressure differential across this large diaphragm since in the raised position of the diaphragm the inherent strength of the diaphragm itself is less involved. A proper setting of the adjusting plate 66 will, therefore, give any desired operating characteristics within the operating range of the control valve.

The valve chamber 24 is connected by a pipe 106 to a fuel pump or any suitable source of fuel under pressure. A pipe 108 connects this valve chamber with the spray nozzle of the internal combustion heater. While this control valve is especially adapted for supplying fuel to the spray nozzle of an internal combustion heater, the pipe 108 may lead to a fuel induction passage wherein the fuel and air are formed into a combustible mixture before admission to the combustion chamber of an internal combustion heater, or any other burner. The device to which the pipe 108 is

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connected should in each case include a metering orifice.

From the foregoing description of my novel control valve, it will be apparent that the spring 82 exerts a downward pressure which urges the floating valve member 30 towards closed position. This spring is relatively light, and its sole function is to hold the valve member 30 in closed position when the heater is not operating and thus to prevent flow of fuel through the pipe 108 to the spray nozzle or other point of utilization. When the pipe 50 is connected to the ventilating air inlet of the heater and the pipe 52 to the ventilating air outlet and there is sufficient flow of ventilating air through the heater for proper operation thereof, the pressure drop across the diaphragm 44 will be sufficient to overcome spring 82 and permit floating valve member 30 to open. This valve member is so designed that it provides a graduated flow of fuel to the heater nozzle depending upon the extent to which this valve member has moved away from its valve seat 28. Such movement of the valve member 30 is accurately controlled by the varying pressure differentials across the diaphragm 44. These pressure differentials, in turn, reflect the varying flow of ventilating air through the heater and, therefore, the proper heat output. In this manner the fuel flow to the heater nozzle is adjusted at all times to the heat requirements of the installation and provides adequate but efficient heater operation.

While I have referred to the pipes 50 and 52 as being connected across the ventilating air side of the internal combustion heater, this arrangement is not essential and may not be the most desirable arrangement in some installations. In certain installations it may be preferable to connect the pipes 50 and 52 across the combustion air side of the heater. In most instances, however, it is preferable to connect the pipes 50 and 52 across the ventilating air side so that the fuel supply to the heater will be cut off if any stoppage occurs in the flow of ventilating air across the heater.

As will be appreciated by a reference to Fig. 1, by a downward adjustment of the central portion of the diaphragm 76 forming a portion of the wall of the fuel chamber 102 so as to bring the strength of the diaphragm more into play in opposition to further downward movement of its central portion, the ratio between the downward pressure on such diaphragm 76 and the upward pressure on the substantially smaller diaphragm 42 forming a portion of the wall of the fuel chamber 24 could be varied, or if desired such diaphragms 42 and 76 might be brought into balanced condition with respect to each other.

While I have illustrated and described only a single embodiment of my invention, it is to be understood that my invention is not limited to the particular details shown and described, but may assume numerous other forms and that my invention includes all modifications, variations and equivalents coming within the following claims.

I claim:

1. A control valve comprising an upper casting, a lower casting, a pair of intermediate castings, a lower diaphragm between said lower casting and one of said intermediate castings, an upper diaphragm between the other of said intermediate castings and said upper casting, a third diaphragm between said intermediate castings, a valve for admitting fuel to a chamber provided in said lower casting beneath said lower di-

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aphragm, means rigidly connecting said diaphragms and adapted to urge said valve toward closed position, a spring urging said last named means and said diaphragms toward valve closing position, conduit means connecting the chamber in the lower casting with a chamber formed in the upper casting above said upper diaphragms, means for adjusting the relationship between said diaphragms, and means for creating a differential pressure across the intermediate diaphragm.

2. A control valve comprising an upper body part, a lower body part, a pair of intermediate body parts, a lower diaphragm between said lower part and one of said intermediate parts, an upper diaphragm between the other of said intermediate parts and said upper part, a third diaphragm between said intermediate parts, a valve for regulating fuel supply to a chamber provided in said lower casting beneath said lower diaphragm, means rigidly connecting said diaphragms and adapted to urge said valve toward closed position, a spring urging said last named means and said diaphragms toward valve closing position, conduit means connecting the chamber in the lower casting with a chamber formed in the upper casting above said upper diaphragm, means for adjusting the relationship between said diaphragms, said upper diaphragm having a different effective area than said lower diaphragm, and means for creating a differential pressure across said third diaphragm.

3. A control valve comprising an upper body part, a lower body part, a pair of intermediate body parts, a lower diaphragm between said lower part and one of said intermediate parts, an upper diaphragm between the other of said intermediate parts and said upper part, a third diaphragm between said intermediate parts, a valve for metering fuel supplied to a chamber provided in said lower part beneath said lower diaphragm, means rigidly connecting said diaphragms and adapted to urge said valve toward closed position, a spring urging said last named means and said diaphragms toward valve closing position, conduit means connecting the chamber in the lower part with a chamber formed in the upper part above said upper diaphragm, said upper diaphragm having a variably different effective area than said lower diaphragm, and means for creating a differential pressure across the intermediate diaphragm.

4. A control valve comprising an upper casting, a lower casting, a pair of intermediate castings, a lower diaphragm between said lower casting and one of said intermediate castings, an upper diaphragm between the other of said intermediate castings and said upper casting, a third diaphragm between said intermediate castings, a valve for regulating fuel delivery to a chamber provided in said lower casting beneath said lower diaphragm, means rigidly connecting said diaphragms and adapted to urge said valve toward closed position, a spring urging said last named means and said diaphragms toward valve closing position, conduit means connecting the chamber in the lower casting with a chamber formed in the upper casting above said upper diaphragm, means for varying the effective area of one diaphragm, and means for creating a differential pressure across the intermediate diaphragm.

5. A control valve comprising an upper casting, a lower casting, a pair of intermediate castings, a lower diaphragm between said lower cast-

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ing and one of said intermediate castings, an upper diaphragm between the other of said intermediate castings and said upper casting, a third diaphragm between said intermediate castings, a valve for regulating fuel flow under pressure to a chamber provided in said lower casting beneath said lower diaphragm, means rigidly connecting said diaphragms and adapted to urge said valve toward closed position in opposition to the direction of fuel flow, said last named means and said diaphragms being biased toward valve closing position, constantly open conduit means connecting the chamber in the lower casting with a chamber formed in the upper casting above said upper diaphragm, and means for creating a differential pressure across the intermediate diaphragm.

6. A control valve comprising an upper part, a lower part, a pair of intermediate parts, a lower diaphragm between said lower part and one of said intermediate parts, an upper diaphragm between the other of said intermediate parts and said upper part, a third diaphragm between said intermediate parts, a valve for admitting fuel to a chamber provided in said lower part beneath said lower diaphragm, means connecting said diaphragms and adapted to urge said valve toward closed position, a spring urging said last named means and said diaphragms toward valve closing position, conduit means connecting the chamber in the lower part with a chamber formed in the upper part above said upper diaphragm, means for adjusting the relationship between said diaphragms, and means for creating a differential pressure across the intermediate diaphragm.

7. A control valve comprising an upper body part, a lower body part, a pair of intermediate body parts, a lower diaphragm, an upper diaphragm, a third diaphragm between said other diaphragms, a valve for regulating fuel supply to a chamber provided beneath said lower diaphragm, means rigidly connecting said diaphragms and adapted to urge said valve toward closed position, conduit means connecting said chamber with a chamber formed above said upper diaphragm, means for adjusting the relationship between said diaphragms, said upper diaphragm having a different effective area than said lower diaphragm, and means for creating a differential pressure across said third diaphragm.

8. A control valve comprising a body, a lower diaphragm in said body, an upper diaphragm in said body, a third and larger diaphragm in said body, a floating valve for metering fuel supplied to a chamber provided in said body beneath said lower diaphragm, means rigidly connecting said diaphragms and adapted to urge said valve toward closed position, a spring urging said last named means and said diaphragms toward valve closing position, means for adjusting said spring, conduit means connecting the chamber with a second chamber formed in the body above said upper diaphragm, said upper diaphragm having a variably different effective area than said lower diaphragm, means for varying the effective area of said upper diaphragm, and means for creating a differential pressure across the intermediate diaphragm.

9. A control valve comprising an upper casting, a lower casting, a pair of intermediate castings, a lower diaphragm between said lower casting and one of said intermediate castings, an upper diaphragm between the other of said intermediate castings and said upper casting, a third dia-

phragm between said intermediate castings, a valve for regulating fuel delivery to a chamber provided in said lower casting beneath said lower diaphragm, means connecting said diaphragms, a spring urging said last named means and said diaphragms toward valve closing position, conduit means connecting the chamber in the lower casting with a chamber formed in the upper casting above said upper diaphragm, means for varying the effective area of one diaphragm, and means for creating a differential pressure across the intermediate diaphragm.

JOHN H. LESLIE, II.

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