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BACKFIRE DOOR

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Fig. 1

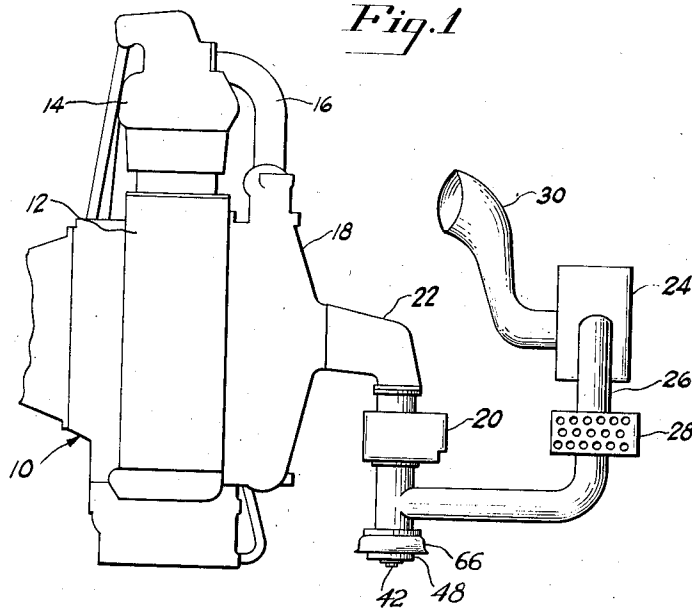
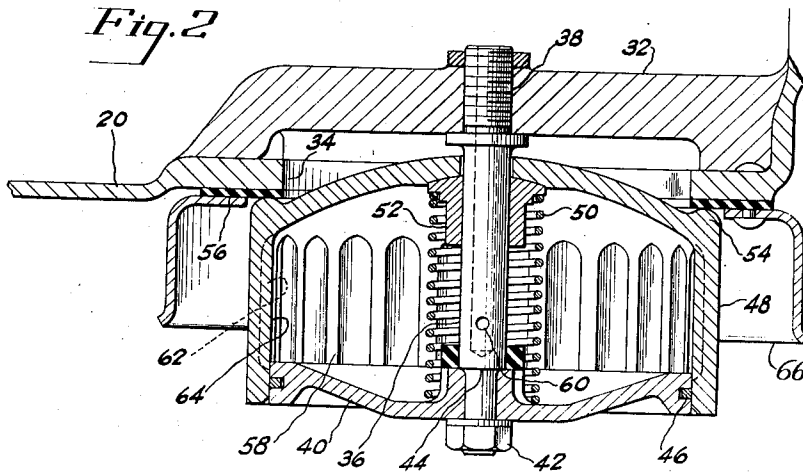


Fig. 2



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BACKFIRE DOOR

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7 Claims. (Cl. 137-53)

This invention relates to improvements in pressure responsive valves and has particular reference to an improved backfire door for an engine fuel induction system.

An object of the invention resides in the provision of an improved backfire door the opening of which is always resisted by substantially the same force regardless of the pressure of the surrounding atmosphere.

A further object resides in the provision of an improved backfire door which will tend to open easily under the influence of a sudden increase in the pressure in the induction system adjacent to the door opening, but which will remain closed under gradual changes in the ratio of the pressures within and without the fuel induction system.

A still further object resides in the provision of an improved backfire door which is light in weight, simple to manufacture, easy to install, and which will not ordinarily get out of order in use.

Other objects and advantages will be more particularly pointed out hereinafter or will become apparent as the description proceeds.

In the accompanying drawing in which like reference numerals are used to designate similar parts throughout, there is illustrated a suitable mechanical embodiment of what is now considered to be the preferred form of the idea of the invention. The drawing, however, is for the purpose of illustration only and is not to be taken as limiting the invention, the scope of which is to be measured entirely by the scope of the appended claims.

In the drawing

Fig. 1 is a schematic elevational view of an internal combustion engine and a fuel induction system therefore showing the application thereof to of the device of the invention.

Fig. 2 is a sectional view on an enlarged scale of the improved backfire door showing in detail the construction thereof.

Referring to the drawing in detail the numeral 10 generally indicates an internal combustion engine of a type ordinarily employed for the propulsion of aircraft. It is to be understood, however, that the device of the invention is not limited to any particular type of internal combustion engine.

The engine is provided with a crankcase 12 supporting a plurality of cylinders, as indicated at 14, to the combustion chambers of which fuel is led through the intake manifolds 16. In the form of engine illustrated, the ends of the in-

take manifolds 16 opposite the cylinder connected ends are connected to a power driven supercharger 18, which will hereinafter be referred to as the primary supercharger. A carburetor 20 is connected to the centrally located inlet opening of the supercharger 18 by a suitable duct 22 for supplying a combustible mixture of fuel and air to the engine. In the arrangement illustrated a second supercharger 24, which will hereinafter be referred to as the auxiliary supercharger, or auxiliary stage, is connected to the carburetor by a suitable air duct 26 within which there is disposed a radiator or intercooler 28. The auxiliary supercharger 24 may receive air from the atmosphere through a suitable duct or scoop 30. As is well-known in the aircraft art, the pressure and density of the atmosphere varies with altitude and an airplane engine is forced to operate at different atmospheric pressures, depending on the flight altitude of the airplane on which it is mounted, to the material detriment to the efficient operation of the engine, unless some means are provided to maintain the pressure in the engine fuel induction system substantially constant. Means for maintaining the pressure in the engine fuel induction system substantially constant are known to the art and an example of such an arrangement is illustrated and described in detail in application Ser. No. 133,160 of Wright A. Parkins, filed March 26, 1937, for Two stage supercharger.

In the illustrative arrangement of an engine fuel induction system shown in Fig. 1, the pressure of the fuel mixture supplied to the cylinder is brought up to a desired predetermined value by the action of the superchargers 18 and 24, and is prevented from exceeding the desired value by suitable throttling means applied to the carburetor 20, so that the pressure of the air in the interior of the carburetor 20 is maintained substantially constant at a predetermined value.

It has been found that with previous backfire door constructions, if a constant pressure is maintained in the carburetor, the resistance of the backfire door to opening changes with the change in the pressure of the surrounding atmosphere so that if sufficient spring resistance is provided to maintain the door tightly closed at very low atmospheric pressures incident to operation at high altitude, at low altitude the resistance of the door to opening will be so great that there will be danger of a backfire in the carburetor failing to open the backfire door and finding its way out of the engine fuel induction system by disrupting the air ducts or the intercooler, if one is pro-

vided. Since the intercooler is usually a relatively delicate structure composed of thin tubes and sheet metal chambers soldered together, it may be considered as one of the objects of this invention to provide a backfire door which will at all times protect such an intercooler against disruption due to excessive pressures incident to backfiring of the engine.

Referring to Fig. 2 the carburetor 20, or the air duct leading to the engine, forming in effect a gas container, is provided with a backfire door supporting rib 32, extending diametrically across the backfire aperture 34 which is conveniently designed as a circular port in the bottom wall, or other outer wall, of the carburetor.

A tubular stem 36 is secured to the rib 32 by suitable means such as the screw threaded connection 38, in such a manner that it projects downwardly concentric with the aperture 34, and terminates below the bottom wall of the carburetor or duct. A disk 40 is secured upon the bottom end of the stem 36 by suitable means such as the nut 42 and shoulder 44, and is provided with a peripheral packing ring 46.

The backfire door itself is in the general form of an inverted cup shaped member 48, provided in its closed end with a concentric aperture through which the pin 36 extends, and having its open end overlying the periphery of the disk 40 and the packing ring 46. The member 48 is resiliently held in its uppermost position by a coiled compression spring 50 disposed between the disk 40 and an abutment 52 slidably mounted on the stem 36 and is provided around the periphery of its closed end with an annular bead 54 which cooperates with a gasket 56 to seal the aperture 34 when the door 48 is in its uppermost position.

By reason of the above described shape and arrangement of the parts a closed chamber 58 is provided between the interior of the cup shaped door member 48 and the disk 40. This chamber is connected with the interior of the carburetor by means of port 60 leading from the interior of the tubular stem 36, the upper end of which is in communication with the interior of the carburetor and the lower end of which is made solid at and below the shoulder 44. The passage through the stem 36 constitutes an orifice for controlling the rate of flow of fluid into the chamber 58. With this arrangement of the parts the air pressure within the chamber 58 is normally the same as the fluid pressure within the carburetor 20 regardless of the pressure of the surrounding atmosphere, but its rate of change in response to pressure changes in the carburetor is controlled by a degree of restriction of the above mentioned orifice.

When a backfire occurs, the door member 48 is moved downwardly to open the port 34 and is moved downwardly against the substantially constant fluid pressure in the chamber 58 so that the door always opens with the same force.

In order to avoid compression of the fluid in the chamber 58 the interior wall of the cylindrical portion of the door member 48 is provided with grooves 62 separated by parallel longitudinally extending ridges 64. As soon as the lower ends of the grooves 62 have passed the peripheral extent of the disk member 40, the chamber 58 is connected with the external atmosphere and the only resistance to the downward movement of the door is the force of the spring 50. As soon as the excess pressure incident to the backfire has been vented, the spring 50 forces the door member upwardly to its closed position and

the pressure in the chamber 58 is again immediately equalized to the pressure existing in the interior of the carburetor.

If desired, the backfire door may be surrounded by a cover member 66 which may be provided with an open flared end to deflect the backfire blast away from the carburetor, or may be connected with a tail pipe leading away from the carburetor.

When the pressure of the external atmosphere is above the pressure in the carburetor, no additional force will be required to open the door since the pressure in the chamber 58 will be below the atmospheric pressure and the same as the pressure in the carburetor, similarly when the atmospheric pressure is below the pressure in the carburetor, the force required to open the door is not changed, since the pressure in the chamber 58 is then above the atmospheric pressure and equal to the pressure in the carburetor. From the above consideration it will be observed that the force required to open the backfire door is substantially constant regardless of variations in the pressure of the surrounding atmosphere.

While there has been illustrated and described a suitable mechanical embodiment of what is now considered to be the preferred form of the idea of the invention, it is to be understood that the invention is not limited to the construction so illustrated and described but that such changes in the size, shape and arrangement of parts may be resorted to as come within the scope of the appended claims.

Having now described the invention so that others skilled in the art may clearly understand the same, what it is desired to secure by Letters Patent is as follows:

1. A backfire door including a movable closure member responsive to sudden increases in fluid pressure on one side thereof to move to open position, a spring urging said closure member to closed position, a variable volume chamber at the opposite side of said closure member, means connecting said chamber with the fluid pressure at said one side of said closure member to maintain in said chamber a fluid pressure effective to balance the fluid pressure tending to move said closure member to open position, said means including an orifice for restricting the flow of fluid to said chamber to retard the changes of pressure in said chamber and provide an interval of unbalanced pressure on the opposite sides of said closure member when the increase of fluid pressure tending to move said closure member to open position takes place at a speed above a predetermined rate, and a normally closed vent for said chamber larger than said orifice opened by initial opening movements of said closure member, whereby said closure member will move to open position in response to a sudden increase in said fluid pressure but will remain in closed position when the increase in fluid pressure is gradual.

2. A backfire door for an engine fuel system including a fuel mixture duct and an intercooler comprising, a relatively light movable closure member for mounting in covering relation with a pressure relief aperture, a chamber at the side of said closure member opposite said aperture, means for connecting said chamber with the fluid pressure on the side of the closure member opposite said chamber for balancing the fluid pressures on the opposite sides of said closure member, said means including a restricted orifice for maintaining said pressures unbalanced under

sudden increases in the fluid pressure on the side of the closure member opposite the chamber, a normally closed vent for said chamber larger than said orifice opened by initial opening movements of said closure member, and a light spring constituting normally the only unbalanced force urging said closure member to aperture covering position.

3. In a pressure actuated valve, a member having substantially equal areas on opposite sides thereof actuatable by fluid pressure on one side thereof to open said valve, a pressure chamber on each side of said member, means for conducting fluid under pressure from the chamber at one side of said member to the chamber at the opposite side thereof to overcome the effect of fluid pressure on one side of said member tending to open said valve, said means including an orifice for restricting the application of fluid pressure to said opposite side of said member, said chamber at said opposite side of said member having an outlet of an area substantially unrestricted in comparison with the area of said orifice opened by an initial opening movement of said member.

4. In a pressure actuated valve, a member having substantially equal areas on opposite sides thereof actuatable by fluid pressure on one side thereof to open said valve, a variable volume fluid pressure chamber on the opposite side of said member adapted to contain a compressible fluid, a spring in said chamber for resiliently urging said member to valve closing position, means for supplying fluid pressure to said variable volume chamber to overcome the effect of fluid pressure on said one side of said member tending to open said valve, said means including an orifice for restricting the application of fluid pressure to said variable volume chamber to maintain the pressure changes in said variable volume chamber at a rate below the rate of increase of pressure applied to said one side of said member when such rate of pressure increase is above a predetermined value, said chamber including passages for relieving fluid pressure therefrom once said valve member has been moved a predetermined amount against the force exerted by the compressible fluid in said chamber.

5. A backfire door for an internal combustion engine carburetor comprising, a supporting housing for said door, a stem projecting outwardly from said housing, a cup shaped door member

slidably mounted on said stem in position to cover a vent opening in said housing, a closure member for the open end of said door member rigidly mounted on said stem, a spring supported by said stem for urging said door member to aperture closing position, a fluid passage extending through said stem to the space between said door member and said closure member, and a fluid passage controlled by said door member for venting said space when said door member moves to open said vent opening.

6. A backfire door for an internal combustion engine carburetor comprising, a hollow stem secured at one end concentrically of a vent opening in a supporting housing, a disc secured upon the other end of said stem, a cup shaped door member slidably mounted on said stem in position to normally close said stem opening, said door member having an annular wall surrounding said disc to provide a closed chamber within said door member, a spring in said chamber holding said door member to vent closing position, a fluid channel extending through said stem from the interior of said housing to the interior of said chamber, and one or more fluid channels in said door member opened by an initial opening movement of said door member to vent said chamber to the atmosphere.

7. In a pressure relief device for a gas container, a valve normally closing an orifice in said container, means resiliently urging said valve to and normally holding said valve in closed position, means including a fluid passage with a restricted orifice connecting the interior of said container with a chamber on the opposite side of said valve for normally equalizing the pressure on opposite sides of said valve to render said resilient means effective to maintain said valve closed regardless of the pressure in said container, said second mentioned means, including the restricted orifice in said fluid passage, causing a delay in said pressure equalization to render said resilient means ineffective to maintain said valve closed when the pressure in said container increases at or above a predetermined rate, and a normally closed vent for said chamber, opened by initial opening movements of said valve for relieving the pressure on the chamber side of said valve to then permit said valve to open wide and rapidly.

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