June 14, 1960 H. G. BOWERS 2,941,061

AUTOMATIC CARBURETOR DEICER CONTROL

Filed April 22, 1958

Fig.1

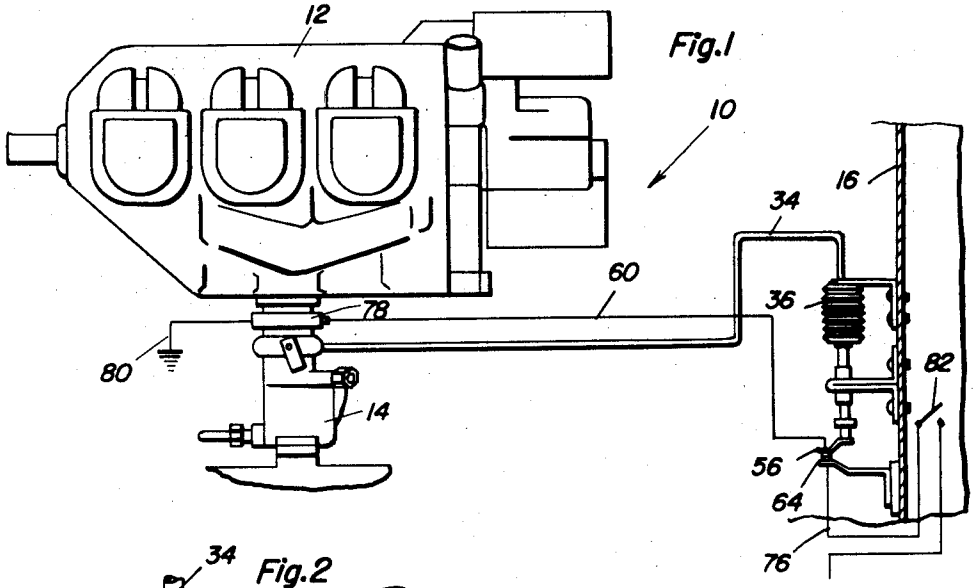


Fig.2

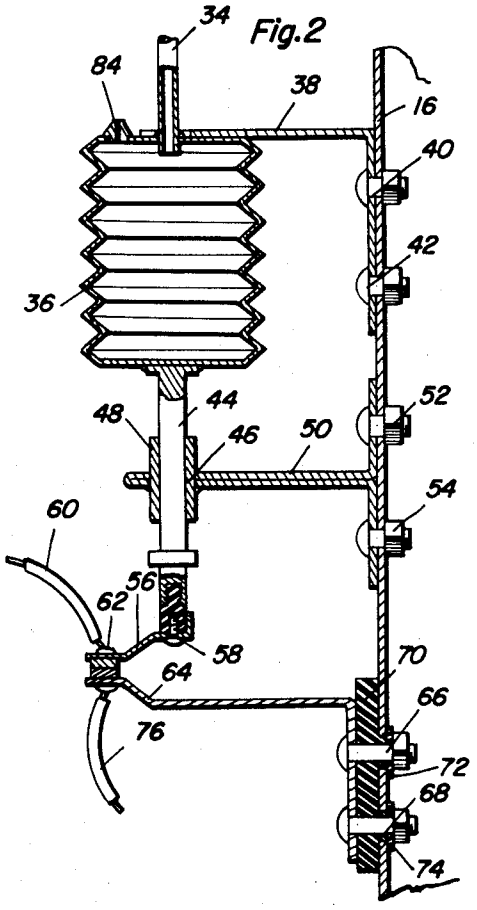


Fig.3

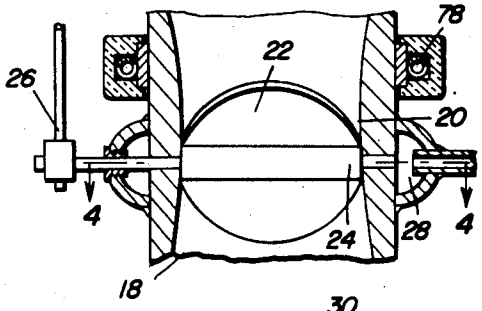
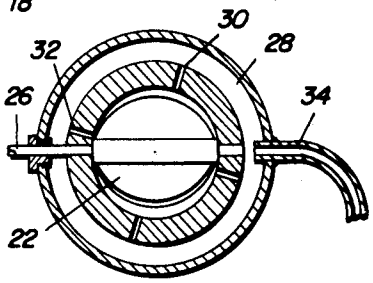


Fig.4



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AUTOMATIC CARBURETOR DEICER CONTROL

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2 Claims. (Cl. 219—19)

This invention relates generally to automatic controls and more particularly to an automatic carburetor ice detector and control particularly designed for utilization in small aircraft.

It is well known that carburetor icing is a frequent cause of engine failure in the operation of small aircraft. The vaporization of fuel combined with the expansion of air as it passes through the carburetor, causes a sudden cooling of the mixture. The temperature of air passing through the carburetor may drop as much as 60° F. within a fraction of a second. Water vapor in the air is "squeezed out" by this cooling and, if the temperature in the carburetor reaches 32° F. or below, a moisture will be deposited as frost or ice inside the carburetor passages. Even a slight accumulation of this deposit will reduce power and may lead to complete engine failure, particularly when the throttle is partly or fully closed.

The carburetor heater is an anti-deicing device which preheats the air before it reaches the carburetor, thus melting any ice or snow entering the intake thereby keeping the fuel mixture above freezing point. On dry days, or when the temperature is well below freezing, the moisture in the air is not sufficient to cause trouble; but if the temperature is between 20° and 70° F., with visible moisture or high humidity, the carburetor heater should be turned on to forestall icing. The heater is often adequate to prevent icing, but it will not always clear out ice which has already formed. The pilot will generally recognize the first signs of icing by an unusual roughness in engine operation together with a loss of r.p.m. When this occurs, the experienced pilot will immediately turn full heat on to prevent increased rapid ice accumulation.

During prolonged glides with closed throttle the carburetor heater may not provide sufficient heat to prevent icing unless the throttle is opened periodically to keep the engine warm. The carburetor heater should not be used more than necessary in that preheating of the air tends to reduce the power output of the engine and to increase the operating temperature. Therefore, the pilot should be careful generally not to use the carburetor heater on warm dry days or on take-off when full power is required unless weather conditions are such as to make the use of the preheat desirable.

In most of today's small aircraft, the pilot must manually operate the carburetor heater at his discretion. Of course, the development of automatic preheat means would considerably lessen the extensive chores of the pilot and further would allow the aircraft to perform more efficiently and safely. Though the prior art indicates that considerable work has been done along these lines, few of the systems developed perform adequately enough for installation in all of today's small aircraft. In accordance with the above, it is the principal object of this invention to provide a novel and improved automatic carburetor deicing system for preventing ice accumulation in the fuel intake line.

It is a further object of this invention to provide an automatic carburetor ice detector and control means for allowing aircraft to perform more safely and efficiently.

It is a further object of this invention to provide automatic carburetor heating means so as to relieve the small aircraft pilot of some tedious discretionary chores.

It is a further object of this invention to provide an automatic carburetor deicing system for preventing ice accumulation of the fuel intake line which is relatively inexpensive compared to more complex systems.

In accordance with the above stated objects, below is described in particularity the principles of a novel and improved automatic carburetor ice detection and control system. The invention takes into account the proven fact that ice first forms in the throat or venturi of the fuel intake line to the carburetor when icing conditions are encountered. Further, it is realized that under normal conditions the high velocity fuel mixture in the throat portion creates a substantial low pressure area. In view of this, a manifold is constructed about the throat portion and communicates with the fuel intake line by a plurality of apertures. The manifold is connected by a tube to brass bellows which are spring urged outwardly. The bellows carry a movable electrical contact thereon which is aligned with a fixed electrical contact proximate thereto. The two electrical contacts form a portion of the preheating circuit which is designed to preheat the air to be mixed with the fuel. Under normal operating conditions, the high velocity in the throat portion causes a substantial vacuum in the manifold which is transmitted to the bellows which in turn are compressed by the outside air pressure so as to overcome the spring urging to open the contacts and denergize the carburetor heater. Under icing conditions, the apertures communicating the manifold with the throat become blocked with ice and the vacuum becomes less effective. The bellows therefor tend to expand due to their spring urging and the contacts close so as to energize the carburetor heater for preheating the air before it is mixed with the fuel. Of course, upon a resumption of the vacuum upon the disappearance of the ice, the bellows will once again become compressed and the contacts will open to shut off the carburetor heat.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

Figure 1 is an elevational view illustrating the general utilization of the system comprising this invention in conjuntion with an airplane engine;

Figure 2 is a blown up elevational view of the bellows portion;

Figure 3 is a sectional view through the throat portion of the fuel intake line; and

Figure 4 is a sectional view taken substantially upon the plane 4—4 of Figure 3.

With continuing reference to the drawing, the numeral 10 generally represents an aircraft engine chamber housing the engine block 12, carburetor 14 and enclosed by a chamber wall 16. A fuel intake line 18 has a throat portion 20 where the mixed fuel and air attain their highest velocity. Circular valve 22 is rotatably supported on a shaft 24 which may be rotated manually through the linkage 26. The combination linkage and valve comprise the engine throttle to control the fuel air intake through the line 18.

A semi-circular manifold 28 extends about the fuel intake line 18 and communicates with the intake line 18

at the throat portion 20 through apertures as 30 and 32, etc. The manifold 28 supports a tube 34 which communicates with the inner portion of the manifold 28 and transmits the air pressure from the manifold 28 to the inner portion of an outwardly spring urged bellows 36. The bellows 36 is supported from a brace member 38 which is bolted to the chamber wall 16 by nut and bolt combinations 40 and 42. The bellows 36 carries a slidable rod 44 which is adapted to longitudinally slide through an aperture 46 formed in a neck portion 48 of frame 50 bolted to the chamber wall 16 by nut and bolt combination 52 and 54. The slidable member 44 has an electrical contact 56 affixed on the end thereof by a screw 58. An electrical conductor 60 is soldered to the terminal 56 as at 62. Opposed to the movable contact 56 is a fixed contact 64 supported on the chamber wall 16 by nut and bolt combination 66 and 68 and insulated therefrom by spacer 70 and washers 72 and 74. A conductor 76 is soldered to the fixed contact 64. The conductors 60 and 76 are connected in a heater circuit 78 and then to ground 80. A manual switch 82 is further incorporated in series in the circuit and is made accessible to the pilot. The carburetor heater 78 may be of any type and may be conventional. The carburetor 78 is located at a point prior to the valve throttle 32 and preheats the incoming air which is to be mixed with the fuel.

In the automatic operation of this device, under normal conditions an extreme velocity of air, will be established in the intake line 18 so that the pressure in the throat 20 will be substantially reduced and a significant vacuum will be established in the manifold 28 through the apertures 30 and 32. This vacuum will of course be transmitted through tube 34 to the bellows 36. The ambient air pressure about the bellows 36 will compress the bellows 36 due to the pressure difference between the outside air and the substantial vacuum within the bellows. The compression of the bellows 36 will slide the member 44 upwardly within the neck 48 and open the contacts 56 and 64 to interrupt the circuit to the carburetor heater 78. Of course, this interruption is desirable under normal operations condition of an aircraft engine.

However, when icing begins to occur, the apertures 30 and 32 will become partially blocked and the normal vacuum established in the manifold 28 will become less effective. Likewise, the vacuum established in the bellows 36 will become less effective and the spring urging of the bellows will slide the member 44 downwardly within the neck 48 so as to electrically connect the contacts 56 and 64. This action will actuate the carburetor heater 78 to preheat the air in the intake line so as to remove any icing that has occurred in the throat area and in the apertures 30 and 32. Of course, upon the elimination of the ice in the apertures 30 and 32, the bellows will once again be compressed as the vacuum is reestablished to turn the carburetor heat off.

The air bleed hole 84 communicates with the inner portion of the bellows 36 to allow the bellows pressure to equalize with the outside pressure if the apertures become completely obstructed with ice.

In summary, therefore, what has been disclosed is an automatic detection and control system for preventing the excessive accumulation of ice in the intake line of an aircraft carburetor. Upon the accumulation of any ice, a motor or solenoid is actuated to turn on carburteor heat to preheat the air in the line to remove the accumualted ice.

It cannot be emphasized too strongly that an important feature of this invention resides in the simplicity of the system, initially assuring a minimum of expense during manufacture and also assuring a high degree of reliability during use. The only moving part is the bellows itself and the electrical contact carried thereby, thus materially reducing the chances of mechanical breakdown.

Essentially then, the invention is based upon the single expedient of utilizing the pressure differential normally existing between the fuel mixture in the throat of the venturi in a carburetor and the ambient atmosphere to maintain a carburetor heater control mechanism inoperative. A connection between the control mechanism and the venturi throat is made in such a manner that the beginning of formation of ice in the throat will at least partially block the connection so that the pressure differential, as transmitted to the control mechanism, is diminished, eventually operating to render the control mechanism operative so as to turn on the conventional carburetor heater and remove the ice.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and changes may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. An automatic carburetor deicing system for an internal combustion engine having a carburetor provided with a venturi within which ice may form, and a selectively operable heater for removing such ice, comprising an air bleed system connected to said venturi for bleeding air into said venturi, said air bleed system including mechanism selectively controlling said heater, said mechanism being operable to deactivate said heater upon free and unobstructed air bleed flow through the air bleed system and being operable to activate said heater upon partial or full obstruction to air bleed flow through the air bleed system, the connection of said air bleed system to said venturi being so located with respect to the latter as to be disposed within the region of ice formation so that the information of ice in the venturi presents the obstruction of the air bleed system, said mechanism being in the form of a bellows mounted for free longitudinal expansion and contraction, and an electrical contact carried by the free end of said bellows for actuating said heater, said heater being in the form of an electrical resistance element surrounding said carburetor in the region of the venturi, an electrical circuit for energizing said resistance element including said electrical contact.

2. An automatic carburetor deicing system for an internal combustion engine having a carburetor provided with a venturi within which ice may form and a selectively operable heater for removing such ice, comprising an air bleed system for sensing the presence of ice within said venturi, said air bleed system including mechanism to control said heater, said carburetor having a chamber provided with passageways leading into the throat of said venturi, said air bleed system including an air bleed opening of a size to establish a negative pressure within said chamber where said passageways are free and unobstructed and permitting the pressure of said chamber to be increased toward ambient pressure when said passageways are partially or fully obstructed, and pressure responsive means connected to said heater for actuating the same when said passageways become partially or fully obstruced by the formation of ice within said venturi, said heater being in the form of an electrical resistance element surrounding said carburetor in the region of the venturi, an electrical circuit for energizing said resistance element including a fixed contact and a movable contact carried by said mechanism, said mechanism being in the form of a bel-

lows mounted for free longitudinal expansion and contraction, said movable contact being carried by the free end of said bellows.

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