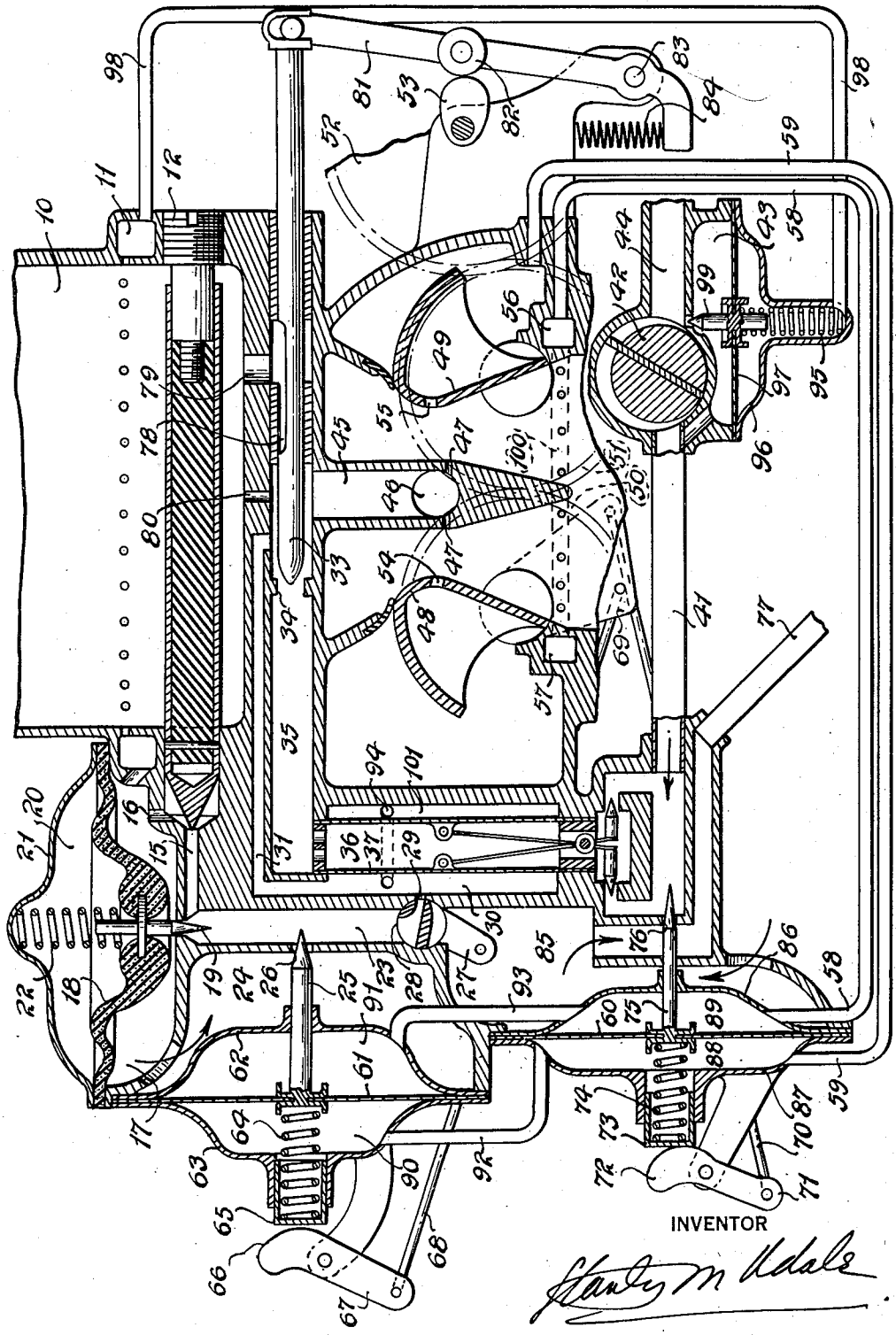
Dec. 2, 1941. S. M. UDALE 2,264,347

MIXTURE CONTROL

Filed Aug. 15, 1938



INVENTOR

Stanley M. Udale

Patented Dec. 2, 1941 2,264,347

UNITED STATES PATENT OFFICE

2,264,347

MIXTURE CONTROL

Stanley M. Udale, Detroit, Mich., assignor to George M. Holley and Earl Holley

Application August 15, 1938, Serial No. 224,959

8 Claims. (Cl. 261—37)

The object of this invention is to improve the operation of an airplane carburetor, so that the mixture ratio is correct for the following variables:

a. Temperature.
b. The pressure in the air entrance leading to the carburetor commonly known as the altitude correction.
c. A correction to correspond to the variations of the air flow at given throttle positions.

The specific form of carburetor to which this invention relates is one in which two streamlined throttles form variable Venturi passages, one on each side of a streamlined partition with which they both engage. In the throat of these variable venturis thus formed, fuel is discharged from a passage located in the streamlined partition. The discharge of this fuel is controlled by a needle valve moved by a cam. The two throttles and the cam operating the needle valve are all geared together so that they move together. By this means, as the throttle opens, the needle moves and the fuel orifice is opened.

Description

In the air entrance 10 of the carburetor is located the air pressure equalizing ring 11. Immediately below is located the thermostatic needle 12. This needle contains a core which has a relatively high coefficient of expansion (plastic material similar to hard rubber). The result is that the needle point 14 moves to the left when the temperature increases and moves to the right when the temperature decreases. This controls the flow of air through an orifice 15 which is connected through a passage 16 to the chamber 17 which is in communication with the piezometer ring 11.

In the chamber 17 is also located the flexible diaphragm 18 which carries the needle valve 19. This diaphragm forms the lower wall of the chamber 20 and a stamped wall cover 21 forms the upper portion. A spring 22 is provided between the cover 21 and the flexible diaphragm 18. The chamber 20 is evacuated so that the diaphragm 18 carries the full atmospheric pressure and is supported by the spring 22. The movement of the needle valve 19 thus responds to changes in atmospheric pressure in the air entrance and to supercharger pressure when used.

The air flowing by the needle valve 19 passes into a passage 23 into which also communicates the passage 15. There is a second chamber 24 in which is located a needle 25 controlling an opening 26 which also admits atmospheric air into the passage 23. The manual lever 27 controls the valve 28 which admits atmospheric air into the passage 23. When the lever 27 moves to the left, the opening 29 is closed and a lean mixture results. A rich mixture is obtained by moving the lever 27 to the right when atmospheric pressure is freely admitted to the chamber 30. The passage 23, thus communicates through the passage 29 with a chamber 30 which communicates with the passage 31 to the fuel needle chamber 32, which surrounds the movable needle 33 which controls the fuel flow through the orifice 34 which is located at the right hand end of a fuel passage 35, which passage communicates with the upper portion of the diaphragm chamber 36.

This diaphragm chamber 36 is provided with two diaphragms 37 and 38 which operate the fuel needle shut off valves 39 and 40 through mechanism of the standard type. These fuel needle valves 39 and 40 are supplied with fuel through a high pressure fuel passage 41. This high pressure fuel is derived from a fuel pump 42 which is provided with a pressure control chamber 43 which permits excess fuel to be returned to the fuel entrance 44 of the fuel pump 42. The result is there is a substantially constant pressure in the pipe 41. The fuel and air flow down the fuel nozzle 45 and discharge into a horizontal passage 46 which is provided with fuel and air outlets 47 which discharge into the throat of the variable venturi.

This variable venturi forms the throttle of the carburetor and is formed from the left wall 48 and the right wall 49. These two walls are geared together by means of gears indicated by broken lines 50 and 51. Engaging with the gear 51 is the throttle control gear 52 which carries the needle control cam 53 which operates the needle valve 33 through a well known mechanism, indicated by the lever 81, roller 82 and spring 84 and fulcrum 83.

The throttle walls 48 and 49 are provided with openings 54 and 55 so that the pressure in back of the throttle walls 48 and 49 is substantially that existing in the throat of the variable venturi. The pressure in the mixture outlet from the carburetor is measured in the channel 56 which corresponds to the piezometer ring 11 except that the passage 56 only extends at right angles to the plane of the drawing and does not surround the air entrance. There is a corresponding passage 57 on the left hand wall which

will be connected with the passage 56 through a passage 100.

The pressure in the passages 56 and 57 is thus the pressure in the mixture outlet. A pipe 58 is connected to the channels 56 and 57. A pipe 59 is connected with the pressure existing back of the throttle wall 49. These two pipes 58 and 59 are operatively connected with two diaphragms 60 and 61. The upper diaphragm 61 moves the needle valve 25 and controls the admission of atmospheric air past the valve 25 into the passage 23. This diaphragm 61 is enclosed between a stamping 62 and a second stamping 63. The movement of the needle valve 25 is controlled not only by the difference of pressure in the two pipes 58 and 59, but also by a spring 64 which seats inside the piston 65. This piston 65 engages with a cam 66 which is pivotally supported on the cover 63. The cam 66 is moved by lever 67 through a rod 68 which is connected with a throttle lever 69 which is interconnected with operating gears 50, 51, 52.

A similar mechanism is used to control the diaphragm 60 comprising a rod 70 connected to the throttle lever 69. The rod 70 is pivotally connected to a lever 71 which is rigidly connected with the cam 72 which engages with the piston 73 which regualtes the compression in the spring 74 which engages with the diaphragm 60. This diaphragm 60 engages with the needle valve 75 which controls the flow through the opening 76, which admits fuel to the power jet 77 along with a certain amount of air which enters freely into the passage 85 leading to the power jet 77.

The pressure of the fuel that flows through the orifice 76 past the needle 75 to the power jet 77 is controlled by the pressure in the diaphragm chamber 43 of the fuel pump 42. The pressure on the diaphragm in the chamber 43 is controlled by a spring 95 which is carried in the stamping 96, which stamping is used to clamp in place the diaphragm 97. The chamber formed between the diaphragms 96 and 97 communicates with the piezometer ring 11 through the pipe 98.

The needle valve 99 thus responds to the pressure in the air entrance 10 and in the event that a supercharger is used, a higher pressure is maintained on the diaphragm 97 and hence a higher pressure is maintained in the pipe 41 and hence a higher flow takes place past the needle valve 75 to the power jet 77. The reason for this detail is that the greater the density of the air, the leaner the mixture produced by the flow of the air through a given venturi. Hence an increase in density of air in the air entrance 10 should be followed by an increase of pressure on the fuel in the passage 41.

Considering next the structural details, the diaphragm 60 is mounted between the two stampings 86 and 87. Four diaphragm chambers are thus formed, 88 and 89 controlling the needle valve 75, just as chambers 90 and 91 control the needle valve 25. These four chambers 88, 89, 90 and 91 are connected together by pipes 92, 93, so that the pressure in the diaphragm chambers 88 and 90 corresponds to the pressure, or vacuum rather, in the throat of the variable venturi at the point 55. The pressure in the diaphragm chambers 89, 91, on the other hand, is the pressure, or vacuum, existing in the mixture outlet, or more specifically, in the channels 56 and 57, assuming that 56 and 57 are connected together by a passage 100.

A passage 94 connects the air chamber 30 with a chamber 101 adjacent the gasoline diaphragm chamber 36.

The pressure or suction in the channel 31 is determined by the suction in the chamber 32 which obtains air through a fixed opening 80 and from a variable opening 78 in the needle valve 33, which opening communicates through 79 with the air entrance 10.

The effect of the outlets 47 is that when the throttle is closed and 78 is open, the suction in chamber 32 is low; when the throttle is half open and 78 is closed the suction in 32 is high. When the throttle is wide open, the suction in 32 is again low. This variation of the suction in the air chambers 30 and 101 depends, therefore, on throttle position.

The reason the nozzle 77 is supplied with fuel under high pressure and the nozzle 47 under low pressure is that the fuel that issues from 47 provides the normal requirements of the engine and the mixture ratio determined by the flow through the orifices 47 is substantially constant. The fuel supply through the nozzle 77 is fuel that is required only when the engine is developing its maximum horsepower, or within thirty per cent of its maximum horsepower, in which range of power extra fuel is needed to prevent the engine overheating. It has been found desirable to separate these two fuel supplies.

What I claim is:

1. An aircraft carburetor having an air entrance, two throttles located therein, a mixture outlet, a fuel pump adapted to supply fuel under an approximately constant pressure of a substantial amount, a fuel chamber having a diaphragm connected thereto, a diaphragm-operated fuel valve therein adapted to reduce the fuel pressure to a relatively low head so as to supply fuel to the carburetor, an air chamber associated with said diaphragm, the pressure therein being adapted to control said head, a carburetor mixing chamber located between the two throttles so as to form a variable mixing chamber therebetween, a combined air and fuel nozzle discharging into the throat of said variable air passage, a fuel passage connecting the fuel diaphragm chamber with said fuel and air nozzle, a restricted air orifice communicating with said fuel and air entrance and connected so as to derive its air from said air entrance, an air passage connecting the air diaphragm chamber with said fuel and air nozzle, a second air passage leading out of the air entrance and communicating with the diaphragm air chamber, valve means associated with said air passages for controlling the pressure in said diaphragm air chamber at a pressure intermediate the pressure in the air entrance and the suction in the throat of the variable air passage, temperature responsive means operatively connected to said valve means and located in said air entrance so as to be responsive to the temperature of the flow of air therein whereby an increase in temperature in the air entrance reduces the pressure in said diaphragm air chamber by progressively subjecting said diaphragm air chamber to the effect of the suction in the throat of said variable air passage.

2. An aircraft carburetor having an air entrance, two throttles located therein, a mixture outlet, a fuel pump adapted to supply fuel under an approximately constant pressure of a substantial amount, a fuel chamber having a diaphragm connected thereto, a diaphragm-operated fuel valve therein adapted to reduce the

fuel pressure to a relatively low head and to supply fuel to the carburetor, an air chamber associated with said diaphragm, the pressure therein being adapted to control said head, a carburetor mixing chamber located between the two throttles so as to form a variable mixing chamber therebetween, a combined air and fuel nozzle discharging into said variable mixing chamber, a fuel passage connecting the fuel diaphragm chamber with said fuel and air nozzle, a restricted air orifice communicating with said fuel and air nozzle and connected so as to derive its air from the air entrance, an air passage connecting the diaphragm chamber with said fuel and air nozzle, a second air passage leading out of the air entrance and communicating with the diaphragm air chamber, valve means associated with said air passages and adapted to control the pressure in said diaphragm air chamber at a pressure intermediate the pressure in the air entrance and the suction in the throoat of the variable air passage comprising temperature responsive means operatively connected to said valve means and located in said air entrance so as to be responsive to the temperature of the air flow therein, pressure responsive means operatively connected to said valve means and responsive to the atmospheric pressure in said air entrance also adapted to control the pressure in said diaphragm air chamber at a pressure intermediate the pressure in the air entrance and the suction in the throat, whereby an increase in temperature and a decrease in atmospheric pressure simultaneously increase the influence of the suction in said air chamber and thus reduce the pressure therein by progressively subjecting said chamber to said suction.

3. An aircraft carburetor having an air entrance, a throttle located therein, a mixture outlet, a fuel pump adapted to supply fuel under an approximately constant pressure of a substantial amount, a fuel chamber having a diaphragm connected thereto, a diaphragm-operated fuel valve therein adapted to reduce the fuel pressure to a relatively low head and to supply fuel to the carburetor, an air chamber associated with said diaphragm, the pressure therein being adapted to control said head, a carburetor mixing chamber located adjacent to the throttle which is adapted to create a variable mixing chamber between the throttle and the walls of the air entrance, a combined air and fuel nozzle discharging into said variable mixing chamber, a fuel passage connecting the fuel diaphragm chamber with said air and fuel nozzle, a restricted orifice communicating with said air and fuel nozzle and adapted to obtain a supply of air from said air entrance, an air passage connecting the air diaphragm chamber with said fuel and air nozzle, a second air passage leading out of the air entrance and communicating with said diaphragm air chamber, valve means associated with said air passages and adapted to control the pressure in said diaphragm air chamber at a pressure intermediate the pressure in the air entrance and the suction in the throat of the variable mixing chamber, temperature responsive means located in the air entrance responsive to the temperature of the air in said air entrance whereby a decrease in temperature controls the pressure in said diaphragm air chamber by progressively subjecting said chamber to the pressure of the air entrance.

4. In an airplane carburetor an air entrance, a throttle valve therein, a mixing chamber formed adjacent to and on the engine side of the throttle, a fuel nozzle discharging therein, a fuel supply chamber, an air chamber associated therewith adapted to control the head on said fuel in said chamber, a passage connecting the said air chamber with the mixing chamber at the point of fuel discharge, a second passage connecting the said air chamber with the air entrance, valve means associated with said air passages and adapted to control the pressure in said air chamber at a pressure intermediate the pressure in the air entrance and the suction in the mixture chamber, temperature responsive means located in the air entrance and responsive to the temperature of the air in said air entrance connected to said valve.

5. In an airplane carburetor an air entrance, a throttle valve therein, a variable mixing chamber formed between the throttle and the walls of the air entrance, a fuel nozzle discharging therein, a fuel supply chamber, an air chamber associated therewith adapted to control the head on said fuel chamber, a passage connecting the said air chamber with the variable mixing chamber at the point of fuel discharge, a restriction in said passage, a second passage from the air chamber leading into the air entrance on the atmospheric side of said throttle, valve means for regulating the relative effect of the atmospheric pressure in the air entrance and the suction in the variable mixing chamber, thermostatic means located in the air entrance adapted to control said valve whereby the fuel mixture ratio is maintained constant independently of temperature changes.

6. In an airplane carburetor an air entrance, a throttle valve therein, a mixing chamber formed adjacent to and on the engine side of the throttle, a fuel nozzle discharging therein, a fuel supply chamber, an air chamber associated therewith adapted to control the head on said fuel in said chamber, a passage connecting the said air chamber with the variable mixing chamber at the point of fuel discharge, a second pasasge connecting the said air chamber with the air entrance, valve means associated with said air passage and adapted to control the pressure in said air chamber at a pressure intermediate the pressure in the air entrance and the suction in the mixture chamber, pressure responsive means responsive to the atmospheric pressure in the air entrance connected to said valve means, temperature responsive means located in the air entrance and responsive to the temperature of the air in said air entrance also connected to said valve means.

7. In an airplane carburetor an air entrance, a throttle valve therein, a mixing chamber formed adjacent to and on the engine side of the throttle, a fuel nozzle discharging therein having a restricted fuel entrance and an enlarged outlet, a fuel supply chamber, an air chamber associated therewith adapted to control the head on said fuel in said chamber, a restricted air passage connecting said air entrance to the enlarged fuel outlet, a second passage leading from said enlarged fuel outlet to said air chamber so as to subject said chamber to the suction in the mixing chamber at the point of fuel discharge, a third passage connecting said air chamber with the air entrance, valve means associated with said air passage and adapted to control the pressure in said air chamber at a pressure intermediate the pressure in the air entrance and the suction in the mixture chamber, temperature responsive means located in the air entrance and

responsive to the temperature of the air flowing through said air entrance connected to said valve.

8. In an airplane carburetor an air entrance, a throttle valve therein, a mixing chamber located adjacent to and on the engine side of the throttle, a fuel nozzle discharging therein having a restricted fuel entrance and an enlarged outlet, a fuel supply chamber, an air chamber associated therewith adapted to control the head on said fuel in said chamber, a restricted air passage connecting the last air entrance to the enlarged fuel outlet, a second passage leading from said enlarged fuel outlet to said air chamber so as to subject said chamber to the suction in the mixing chamber at the point of fuel discharge, a third air passage connecting said air chamber with the air entrance, valve means associated with said air passage and adapted to control the pressure in said air chamber at a pressure intermediate the pressure in the air entrance and the suction in the mixing chamber, pressure responsive means responsive to the atmospheric pressure in the air entrance connected to said valve means, temperature responsive means located in the air entrance and responsive to the temperature of the air flow through said air entrance also connected to said valve means.

STANLEY M. UDALE