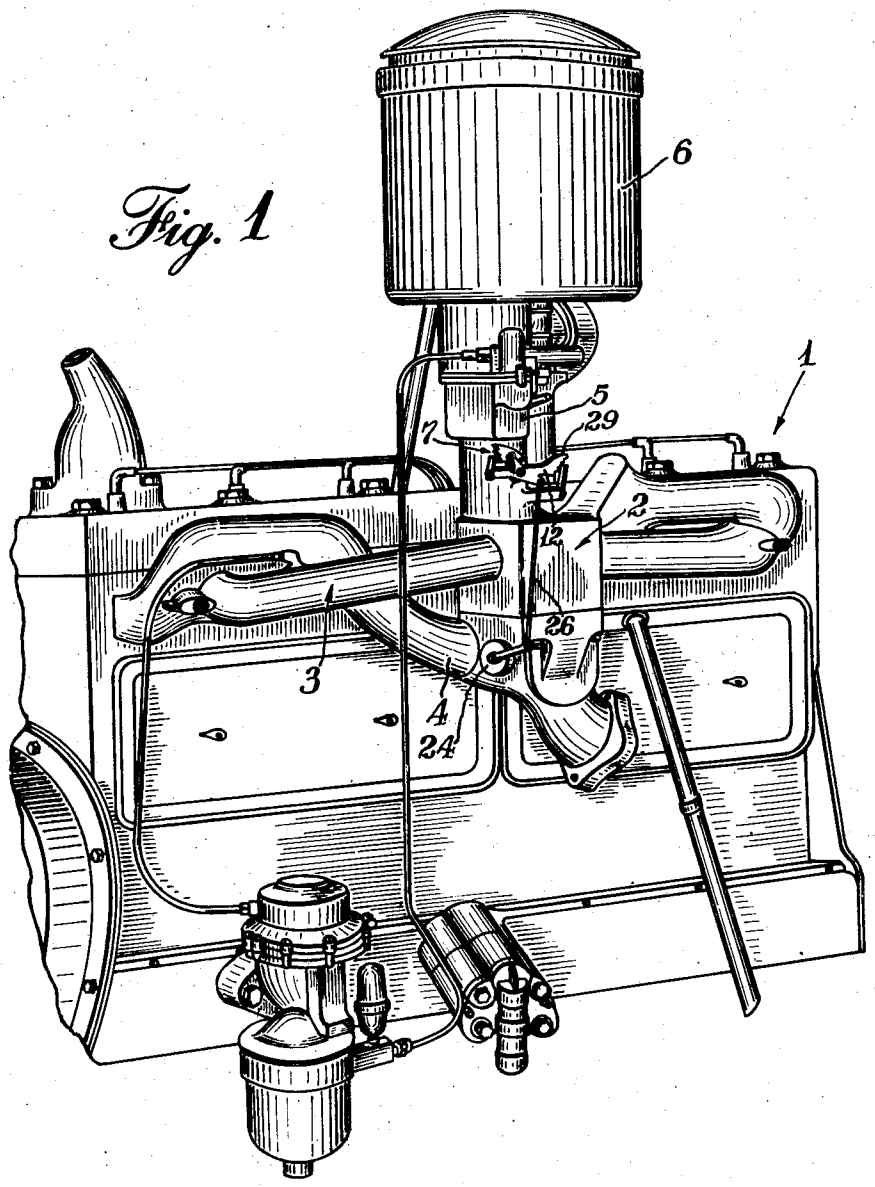
Feb. 12, 1946. F. T. CHRISTIAN 2,394,665

AUTOMATIC CONTROL FOR CARBURETOR CHOKE VALVES

Filed March 23, 1944 3 Sheets-Sheet 1

Fig. 1



Witness:
Burr W. Jones

INVENTOR.
Frank T. Christian
BY Clinton S. James.
ATTORNEY

Feb. 12, 1946. F. T. CHRISTIAN 2,394,665

AUTOMATIC CONTROL FOR CARBURETOR CHOKE VALVES

Filed March 23, 1944 3 Sheets-Sheet 2

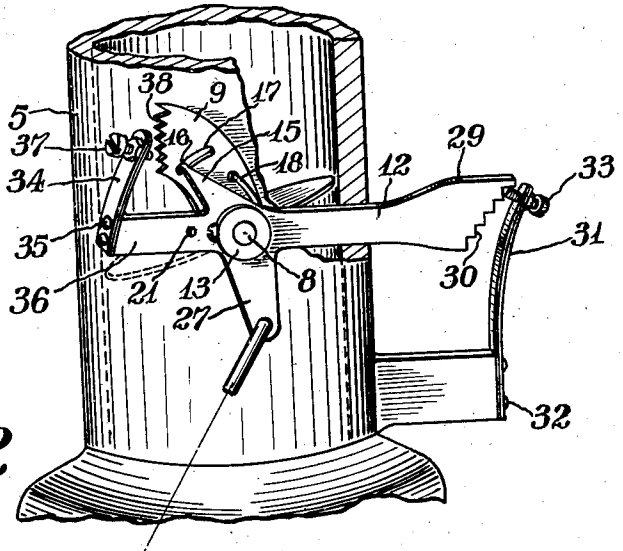
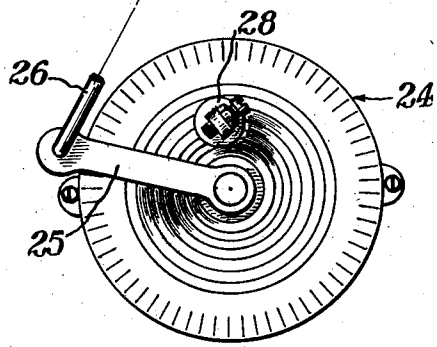


Fig. 2



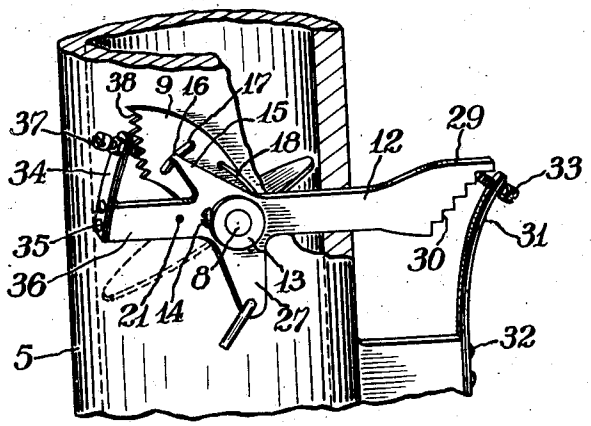


Fig. 3

INVENTOR.
Frank T. Christian
BY Clinton S. Janes.
ATTORNEY

Witness:
Burr W. Jones

Feb. 12, 1946. F. T. CHRISTIAN 2,394,665

AUTOMATIC CONTROL FOR CARBURETOR CHOKE VALVES

Filed March 23, 1944 3 Sheets-Sheet 3

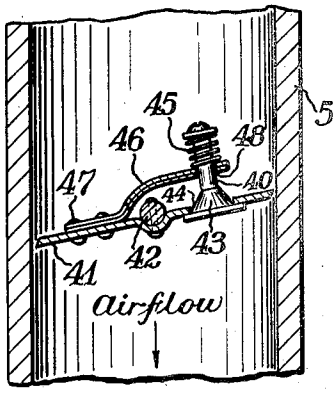


Fig. 5

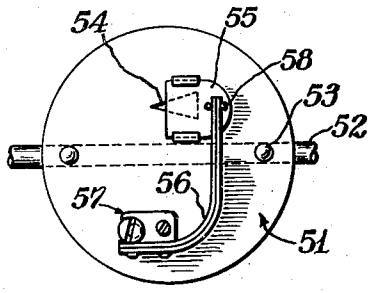
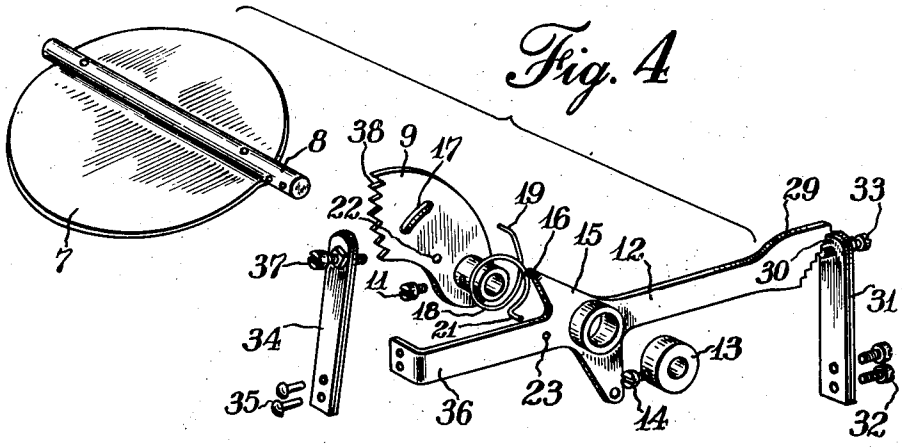


Fig. 6

Fig. 4



INVENTOR.
Frank T. Christian
BY Clinton S. James
ATTORNEY

Witness:
Burr W. Jones

Patented Feb. 12, 1946

2,394,665

UNITED STATES PATENT OFFICE

2,394,665

AUTOMATIC CONTROL FOR CARBURETOR CHOKE VALVES

Frank T. Christian, Elmira, N. Y., assignor to Bendix Aviation Corporation, South Bend, Ind., a corporation of Delaware

Application March 23, 1944, Serial No. 527,850

4 Claims. (Cl. 261—39)

The present invention relates to an automatic control for carburetor choke valves and more particularly to a device for accurately controlling the amount of opening of a choke valve in accordance with ambient temperatures.

To start an internal combustion engine when cold, it is necessary to furnish to it a fuel mixture which is richer in hydrocarbon content than the normal operating ratio. It is customary to accomplish this result by placing a valve in the intake of the carburetor which when closed restricts the admission of air to the carburetor. During cranking, closure of this choke valve causes a partial vacuum in the air passages of the carburetor which aspirates the fuel from the float chamber and thereby furnishes a rich fuel mixture to the engine cylinders. When the engine fires, the rapid acceleration of its pistons causes an increase in the intake vacuum so it is necessary to partially open the choke valve at once to avoid flooding the engine with raw fuel. On the other hand, if the choke is opened too far, the carburetor will supply the normal operating mixture which is too lean for a cold engine, and the engine will promptly die.

It is now common practice in automotive installations to control the choke valve by means of a thermostat which closes the valve when the engine is cold, and gradually opens the choke as the engine warms up. The immediate partial opening of the choke when the engine starts is usually secured by means of a spring-loaded section of the choke valve which is intended to open in response to a predetermined reduction of pressure within the carburetor or by means of an unsymmetrical mounting of the choke valve whereby it will partially open against the pressure of a spring when the engine fires.

Such installations as now generally used have no accurate control of choking in accordance with variations in ambient temperatures, and it has therefore been the practice in designing such structure to assume that it is better to have the mixture too lean than too rich. This is based on the proposition that if the engine is once flooded, the choke valve would remain closed, thus aggravating the condition so that the engine never will start, whereas if the mixture is too lean, the engine may false start a number of times but will finally get warm enough to run. This practice of supplying a mixture which is too lean for the purpose of starting at a very cold temperature has made it difficult if not impossible to start an engine by ordinary means when the temperature is more than 25 degrees or 30 degrees below zero.

It is an object of the present invention to provide a novel carburetor choke valve control that accurately limits the degree of closure of the valve during cranking in accordance with ambient temperature conditions.

It is another object to provide such a device incorporating means for reducing the richness of the mixture when the engine fires, the amount of such reduction being also under accurate control in accordance with the ambient temperature.

It is a further object to provide such a device that regulates the admission of air to the carburetor in accordance with the ambient temperature both during cranking and during the initial period of self operation of the engine.

Further objects and advantages will be apparent from the following description taken in connection with the accompanying drawings, in which:

Fig. 1 is a general view in perspective of an internal combustion engine of conventional type incorporating a preferred form of the present invention.

Fig. 2 is an enlarged detail of a carburetor intake passage having a preferred form of the controlled choke mechanism installed therein, the choke being shown in cranking position with low ambient temperature.

Fig. 3 is a view similar to Fig. 2 showing the parts in the positions assumed when the engine initially fires.

Fig. 4 is an exploded view of the parts of the choke mechanism showing their relative positions and method of assembly.

Fig. 5 is a vertical sectional detail of an embodiment of the invention employing a spring loaded section of the choke valve to provide admission of additional air when the engine fires, and

Fig. 6 is a detail plan view of a form of choke valve in which the thermostatic control of the tightness of closure is mounted directly on the choke valve itself.

In Fig. 1 of the drawings, there is illustrated a conventional form of internal combustion engine indicated generally by 1 having a carburetor 2, intake manifold 3, and exhaust manifold 4. Intake passage 5 of the carburetor which transmits air from the air cleaner 6 has mounted therein a choke valve 7, the control of which is the subject matter of the present invention.

As best shown in Figs. 2 and 4, the choke valve 7 is unsymmetrically fixed to a cross shaft 8

journalled in the intake passage 5 of the carburetor so that air pressure on the valve will tend to open it by rotating it in a counter-clockwise direction. Rotation of shaft 8 and consequently of valve 7 is controlled by means of a quadrant 9 fixed in any suitable manner as by means of a set screw 11 on the shaft 8 where it projects from the intake passage 5. An actuating member 12 is freely journalled on the shaft 8 adjacent the quadrant 9, being retained on the shaft by a collar 13 fixed as by means of a set screw 14 on the end of the shaft. Member 12 is provided with an arm 15 having a laterally projecting finger or pin 16 which extends into an arcuate slot 17 in the quadrant 9 whereby relative angular movement between the actuating member and the quadrant is limited by the length of said slot.

Yielding means for rotating the quadrant 9 in a clockwise direction with respect to the actuating member 12 is provided in the form of a spring 18 which is wrapped around the shaft 8 and has terminal projections 19 and 21 arranged to enter openings 22 and 23 in the quadrant 9 and actuating member 12 respectively. The spring 18 thus functions to normally hold the quadrant at the limit of its clockwise or choke-closing movement with respect to the actuating member 12 as defined by engagement of the pinion 16 in the end of the slot 17 as shown in Fig. 2.

Means of conventional type for closing the choke valve when the engine is cold, and for opening the valve when the engine warms up is provided in the form of a spiral thermostatic member 24 mounted on the exhaust manifold 4 of the engine so as to become heated when the engine is in operation, the outer end of the thermostat being anchored and the inner end having attached thereto an arm 25 which is connected to the actuating member 12 by means of a link 26 pivoted to an arm 27 extending downwardly from said actuating member. The thermostat 24 is so arranged that a rise in temperature thereof causes the arm 25 to move in a clockwise direction thus imparting counter-clockwise rotation to the actuating member 12 which rotation is transmitted through the finger 16 to the quadrant 9 to open the choke valve 7, the rotary movement of arm 25 being limited by any suitable means such as a stop 28 which is so positioned that the choke valve is in a vertical position when the arm 25 engages said stop.

According to the present invention, means are provided for controlling the tightness of closure of the choke valve 7 in accordance with variations in ambient temperature when the engine is cold. As here shown, this means is in the form of an arm 29 extending laterally from the actuating member 12 and having inclined steps or teeth 30 formed thereon, and a thermostatic member 31 fixedly mounted at one end on the body of the carburetor as indicated at 32 and having on its free end an adjustable stop 33 arranged in the path of movement of said teeth 30. Thermostat 31 is arranged to bend away from the arm 29 in response to a lowering of its temperature whereby at very low temperatures the stop 33 will not engage the teeth 30 until the actuating member has rotated sufficiently to close the choke valve tightly, whereas at more moderate temperatures the stop 33 will engage the teeth at intermediate points thus preventing complete closure of the choke valve to a degree depending upon the ambient temperature.

Means are also provided for controlling, in accordance with ambient temperature, the amount that the choke valve is permitted to open when the engine fires. As shown more particularly in Figs. 2 and 3, this means is in the form of a thermostatic member 34 anchored as indicated at 35 to an arm 36 of the actuating member and having at its free end an adjustable stop 37 in the path of movement of inclined steps or teeth 38 formed on quadrant 9. Thermostat 34 is arranged to bend toward the quadrant 9 when its temperature is lowered so that at very low temperatures it will engage a tooth of the quadrant after only a very slight rotation thereof and will consequently closely limit opening movement of the valve 7 relative to the actuating member 12. At more moderate temperatures, however, the stop 37 will be retracted from the quadrant 3 to allow proportionately more rotation thereof.

In operation, let it be assumed that the engine is cold and the ambient temperature is quite low as for instance in the neighborhood of 20 degrees below zero. The positions of the parts under such conditions are as illustrated in Fig. 2 in which the arm 25 of the thermostat 24 has rotated counter-clockwise until its movement was stopped by engagement of the teeth 30 in the arm 29 of the actuating member with the stop 33. Since the temperature is quite cold, the stop 33 is so far withdrawn that it engages with the next to the last tooth 30, and the choke valve 7 is almost completely closed. The thermostat 34 is advanced toward the quadrant 9 by the low temperature until it is in position to engage the first or second tooth 38 of the quadrant 9. When the engine is cranked under these circumstances, a high degree of choking effect is secured due to the almost complete closure of the choke valve. When the engine fires, the consequent rapid acceleration of its pistons causes a comparatively high vacuum to be formed within the carburetor whereby the external pressure on the choke valve causes it to rotate against the force of the spring 18 due to the unsymmetrical mounting of the valve on the shaft 8, as shown in Fig. 3. This rotary movement of the valve is limited to a very small amount due to the almost immediate engagement of the stop 37 with a tooth 38 of the quadrant 9 whereby only a small amount of additional air is admitted into the carburetor, and the mixture is maintained sufficiently rich to insure continuous operation of the engine. After the engine warms up, the thermostat 24 receives heat from the exhaust manifold 4, whereby the arm 25 rotates in a clockwise direction gradually moving the choke valve 7 into its wide open position in the usual manner.

If, during the starting operation, the temperature is more moderate, as for instance zero degrees or higher, the stop 33 engages in one of the lower teeth 30 of the actuating member 12, thus holding up the choke valve to a greater extent in accordance with such moderation of temperature. At the same time, stop 37 is also retracted from the quadrant 9 by such rise in temperature so that it will permit a greater rotation of the choke valve before engagement with the quadrant, whereby a larger amount of additional air is permitted to enter the carburetor when the engine fires. It will thus be seen that there is here provided a positive and accurate control of the choking effect both during cranking and during the initial explosions of the engine whereby the mixture during this critical period is enriched to a degree which conforms closely to the prevalent temperature conditions.

In Fig. 5 of the drawings there is illustrated an embodiment of the invention in which the control of additional air when the engine starts is effected by a spring-loaded portion of the choke valve. As there shown, the choke valve 41 is symmetrically mounted on its shaft 42 and a poppet valve 43 is mounted in an opening 44 in the choke valve. The poppet valve is normally held in closed position by means of a compression spring 45 on its stem 40 and the pressure of said spring is varied in accordance with ambient temperature by means of a thermostatic member 46 anchored at 47 to the choke valve and having an opening 48 in its free end adapted to loosely receive the stem 40 of the poppet valve. The thermostat 46 thus forms an abutment for the spring 45, and is so arranged that a reduction of temperature causes the thermostat to bend upwardly thus applying pressure to the spring 45 and correspondingly reducing the amount of opening of the poppet valve 43 when the engine fires.

In this embodiment of the invention, the shaft 42 may be connected rigidly to the actuating member 12 and the operation of the thermostatic control 34 and choke limiting device 31 etc. will take place in the manner above set forth. When the engine fires, however, the additional air intake is permitted in this instance by the opening of the poppet valve 43 as controlled by the spring 45 and thermostat 46 instead of by the rotation of the choke valve as in the first embodiment.

In Fig. 6 of the drawings, there is illustrated an embodiment in which the control of initial choking effect is accomplished by means of a thermostat mounted directly on the choke valve. As here shown, the choke valve 51 is fixed on shaft 52 by suitable means such as indicated at 53 and an opening 54 is provided in the valve which opening is controlled by a sliding damper on valve member 55. The opening 54 is preferably wedge shaped and the position of the valve 55 is determined by a thermostatic member 56 anchored as at 57 to the choke 51 and connected at its free end to the slide valve 55 as indicated at 58. Thermostat 56 is arranged to bend in such a direction as to close the opening 54 responsive to reduction in temperature.

In this embodiment, the choke valve 51 is closed tightly either by hand operation or by thermostatic means whenever the engine is cold and it is desired to start. The choking effect during cranking is controlled by the position of the slide valve 55 which is actuated by the thermostat 56 to uncover more or less of the opening 54 dependent upon temperature conditions. It will be understood that if the choke 51 is manually operated, it will be incumbent upon the operator to open the valve slightly when the engine fires in order to prevent flooding. If the valve is thermostatically operated, an arrangement such as illustrated in either Figs. 1 to 4 or Fig. 5 may be used to accurately meter the amount of additional opening when the engine fires.

Although certain embodiments of the invention have been shown and described in detail it will be understood that other embodiments are possible and that various changes may be made in the design and arrangement of the parts without departing from the spirit of the invention as defined in the claims appended hereto.

What is claimed is:

1. In combination with a carburetor having an air intake passage, a butterfly valve pivotally mounted in said passage, said valve being so unsymmetrically mounted that atmospheric pressure thereon tends to open the valve, a rotatable shaft traversing said passage forming the mounting means for the valve, an actuating member journalled on the shaft, yielding means for connecting the shaft and actuating member, tending to rotate the shaft with respect to the actuating member in a direction to close the valve, and thermostatic means mounted on the actuating member for restricting in accordance with ambient temperatures the movement of the shaft with respect to the actuating member in the direction to open the valve.

2. An automatic choke valve control for carburetors as set forth in claim 1 in which said restricting means comprises a toothed quadrant rigidly connected to the shaft, and a bi-metallic member mounted on the actuating member in position to engage various teeth of the quadrant dependent on the temperature of the bi-metal.

3. In an automatic choke control for carburetors the combination with a choke valve which is so unsymmetrically mounted that it tends to open automatically when the engine starts, actuating means including a thermostat and a yielding connection for closing the valve when cold and opening the valve when hot, an adjustable thermostatic abutment adapted to engage an element of said actuating means to limit the closing movement of the valve in accordance with the ambient temperature, and an adjustable thermostatic means for limiting in accordance with ambient temperature the deflection of said yielding connection by opening of the valve when the engine starts.

4. In combination with a carburetor having an air intake passage, a butterfly valve pivotally mounted in said passage, said valve being so unsymmetrically mounted that atmospheric pressure thereon tends to open the valve, a rotatable shaft traversing said passage forming the mounting means for the valve, an actuating member journalled on the shaft, yielding means for connecting the shaft and actuating member, tending to rotate the shaft with respect to the actuating member in a direction to close the valve, and thermostatic means mounted on the carburetor adapted to engage said actuating member to hold the valve slightly open to an extent dependent on the ambient temperature, said holding means comprising a toothed arm on the actuating member and a bi-metallic member fixed on the body of the carburetor in position to engage various teeth of the arm dependent on the temperature of the bi-metal.

FRANK T. CHRISTIAN.