Jan. 26, 1943. G. R. SISSON 2,309,419

MIXTURE CONTROL FOR INTERNAL COMBUSTION ENGINES

Filed Oct. 9, 1931

Fig. 1.

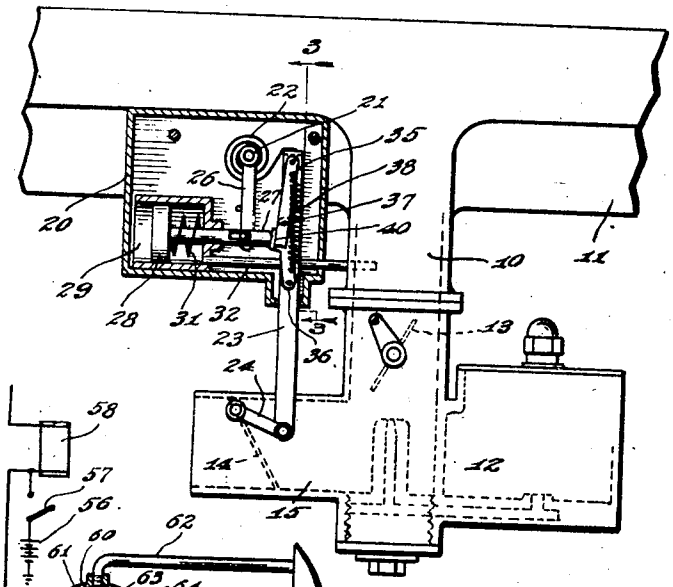
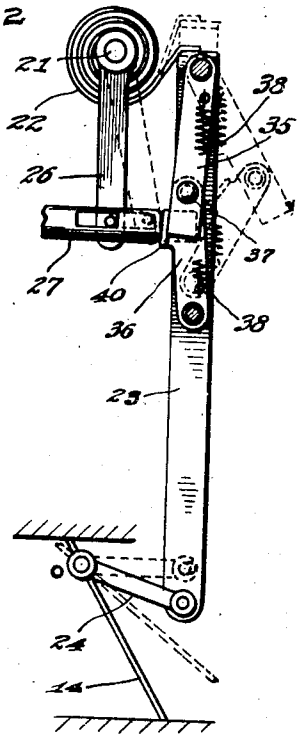


Fig. 2.



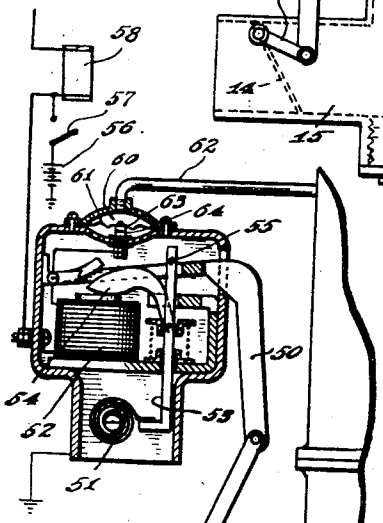


Fig. 4.

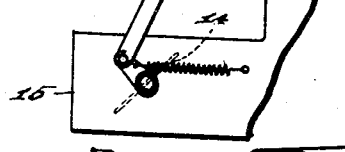


Fig. 5.

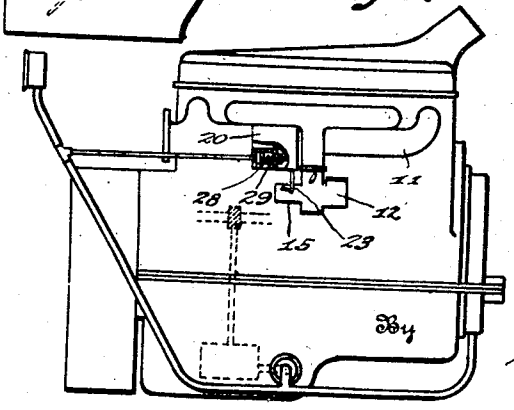
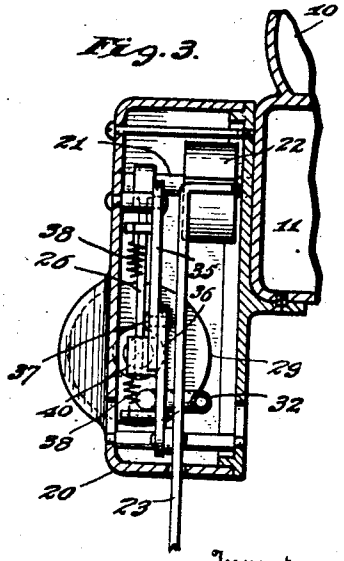


Fig. 3.



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By

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UNITED STATES PATENT OFFICE

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MIXTURE CONTROL FOR INTERNAL COMBUSTION ENGINES

Glen R. Sisson, Pendleton, Ind.

Application October 9, 1931, Serial No. 567,817

7 Claims. (Cl. 123—119)

My invention is concerned with internal combustion engines of the type to which an explosive mixture is supplied by means of a carburetor or other charge-forming device.

It is the object of my invention to provide a control mechanism for the carburetor or charge-forming device which control mechanism will serve, while the engine is being cranked, automatically to increase the richness of the explosive mixture to an extent depending upon temperature, and which will also serve to control the richness of the mixture in accordance with temperature after the engine is started.

In carrying out my invention I provide in association with the carburetor a mixture-enriching device such, for example, as the usual choke-valve, and I control this device jointly by a means responsive to temperature and a means which undergoes a change of position or condition when the engine becomes self-operative after having been at rest. These various elements are associated in such a way that the richness of the mixture formed in the carburetor is decreased when the engine becomes self-operative and is decreased further when the engine-temperature rises.

The accompanying drawing illustrates my invention: Fig. 1 is an elevation of the intake and exhaust manifolds and the carburetor of an engine showing my mixture-controlling device in position; Fig. 2 is an enlarged fragmental view similar to Fig. 1; Fig. 3 is a vertical section on the line 3—3 of Fig. 1; Fig. 4 is a view generally similar to Fig. 1, but showing a modification of my invention; and Fig. 5 is a side elevation of an automobile engine showing a still further modification.

My invention is not concerned with any particular type of engine. In the drawing I have illustrated in detail, therefore, only certain parts of the engine such as the inlet manifold 10, the exhaust manifold 11, and a carburetor 12. The carburetor embodies the usual throttle valve 13 and the customary choke-valve 14, the latter being located in the carburetor air-inlet 15. In embodying my invention in association with the various engine-elements just referred to, the automatic control may be exerted on the choke-valve 14 which, as is well known, serves to increase the richness of the mixture as it is moved toward closed position.

Various parts of the control mechanism are conveniently enclosed in a casing 20 which is preferably mounted adjacent the exhaust manifold 11 of the engine. Within the casing I mount a transversely extending shaft 21 to which is anchored the inner end of a spirally wound bi-metallic strip 22, the outer end of which bears upon an abutment provided at the upper end of a link 23. The lower end of the link 23 is connected to an arm 24 that is rotatable with the choke valve 14.

The bi-metallic strip 22 is but one example of a temperature-responsive element which may be used in carrying out my invention. In the arrangement illustrated in the drawing, the strip is arranged with the metal of higher expansion-coefficient toward the outside in order that the free end of the strip 22 may rise and permit upward movement of the link 23 to open the choke valve 14 upon an increase in the temperature to which the bi-metallic strip 22 is subjected.

Fixed to the shaft 21 I provide a downwardly extending arm 26 operatively connected to a piston rod 27 which carries a piston 28 disposed in an associated cylinder 29. A yielding means, such as a spring 31, acts upon the piston 28 or piston rod 27 tending to move it to the left in Fig. 1, thus tending to depress the free end of the bi-metallic strip 22 to lower the link 23 and move the choke-valve 14 toward closed position. The right-hand end of the cylinder 29 is connected through a suitable conduit 32 with the intake manifold 10 of the engine in order that the piston 28 may be subjected to the pressure existing in the intake conduit of the engine above the throttle valve 13. The left-hand end of the cylinder 29 is in communication with the atmosphere.

Some means, a particular form of which will hereinafter be described, is provided for maintaining the upper end of the link 23 in contact with the free end of the bi-metallic strip 22 in order that the choke valve 14 will be moved toward open position as the temperature increases and the free end of the bi-metallic strip 22 moves upward.

When the engine is at rest, and therefore comparatively cold, the parts of my device occupy the respective positions illustrated in Fig. 1 and in full lines in Fig. 2. That is, the choke-valve 14 is closed, and the piston 28 is displaced from the right-hand end of the cylinder 29. If, under these conditions, the engine is cranked for the purpose of starting it, an enriched mixture will pass through the intake manifold 10 to the engine. The flow of this mixture will be accompanied by a slight drop in pressure within the manifold 10; but since the cranking speed of

the engine is slow, this pressure-drop will be low and will be insufficient to move the piston 28 to the right in opposition to the force exerted upon it by the spring 31. When, however, the engine becomes self-operative, the rate of mixture-flow through the manifold 10 increases, and the pressure within the manifold drops to a value sufficient to cause the piston 28 to move to the right. The resulting movement of the piston rod 27 rocks the shaft 21 in a counter-clockwise direction, elevates the free end of the bi-metallic strip 22, and causes a partial opening of the choke-valve 14, as indicated in dotted lines in Fig. 2, thus decreasing the richness of the mixture supplied to the engine by the carburetor 12. As the engine continues to run, its temperature increases, thus causing a further elevation of the free-end of the bi-metallic strip 22 and a further opening of the choke-valve 14. The parts are arranged in such a manner that when the engine reaches normal operating temperature the choke-valve 14 will be substantially completely open.

Manufacturers of carburetors frequently employ a choke valve which is unbalanced, being so arranged that air-flow past it tends to move it toward open position. This tendency is, of course, especially pronounced when the choke-valve is closed, and may be so pronounced as to cause partial opening of the choke-valve when it would otherwise be held closed by the bi-metallic strip 22. To prevent any such action, I may employ means for locking the choke-valve in closed position until after the engine has become self-operative. In Figs. 1 and 2, such a locking means in the form of a toggle is illustrated. The toggle lock just referred to comprises two links 35 and 36 which are pivotally interconnected at 37. The upper end of the upper link 35 is pivoted at a fixed point in the casing 20; while the lower end of the lower link 36 is pivotally connected to the choke-valve adjusting link 23. Acting between the toggle links I provide a spring 38 which tends to raise the choke-valve adjusting link 23. The points of attachment of the spring 38 to the links 35 and 36 are off-set to the right of the centerlines of the respective links in order that the spring 38 will tend to move the center toggle-pivot 37 to the left when the three pivot points of the toggle are in line, which condition exists when the choke-valve 14 is completely closed. One of the toggle-links, here shown as the link 36, is provided with an abutment 40 which engages the other toggle-link to limit leftward movement of the middle toggle-pivot 37.

With the construction as described, the choke-valve 14 will be held in closed position until the toggle comprised by the two links 35 and 36 is broken; for the choke-valve adjusting link 23 cannot move upward and the choke-valve cannot open as long as the middle toggle-pivot 37 lies to the left of the line through the end toggle-pivots.

By disposing the abutment 40 in line with the end of the piston rod 27, the toggle may be broken by rightward movement of the piston rod 27 which occurs when the engine becomes self-operative. To permit the breaking of the toggle without disturbing the shaft 21, the connection between the arm 26 and the piston rod 27 may have a degree of lost-motion sufficient to permit the piston rod 27 to move to the right far enough to break the toggle without rocking the shaft 21.

Except when the toggle is locked, as illustrated in full lines in Fig. 2, the spring 38 tends to hold the link 23 in contact with the free end of the bi-metallic strip 22, as is clear from the dotted-line position shown in Fig. 2.

Instead of subjecting the piston 28 to the pressure existing within the intake manifold 10, it may be subjected to some other pressure which undergoes a material change when the engine becomes self-operative. This, in Fig. 5, I have illustrated an arrangement in which the left-hand end of the cylinder 29 is closed and connected to an oil-line of the oiling system of the engine. At the low speed of cranking, the pressure within the oil-circulating system of the engine will be insufficient to displace the piston against the action of the spring 31; but when the engine becomes self-operative, the pressure exerted by the oil on the piston 28 is increased to such an extent that the piston is moved to the right in the same manner as that in which it is moved in the construction illustrated in Fig. 1.

From the construction described, it will be apparent that the position of the choke-valve, and therefore the richness of the mixture produced in the carburetor 12, will be dependent upon whether or not the engine is running under its own power and also upon engine temperature. As previously described, the device provides a temporarily enriched mixture during the starting operation and abruptly decreases the richness of the mixture when the engine becomes self-operative, and then gradually decreases the richness of the mixture as the engine-temperature increases until a normal mixture is produced when the engine reaches normal operating temperature. Should the engine be stopped after having reached normal temperature, differential pressure on the piston 28 will be relieved and the spring 31 will move the piston to the left to depress the free end of the bi-metallic strip 22 and move the choke-valve toward closed position. The extent of the choking thus produced will depend upon engine temperature, being greater when the engine is cold than when the engine is hot. This is a distinct advantage of my device for it provides a partial and desirable choking action during starting of the engine even when the engine is hot.

If desired, the strength of the spring 31 may be made such as to exert a control on the choke-valve 14 while the engine is running, in accordance with varying conditions. Thus, it is well known that a cold engine will operate with a predetermined degree of choking at low speeds but that it will fail to operate satisfactorily as the result of too lean a mixture if the throttle is suddenly opened to increase engine-speed. Variations of the pressure within the intake manifold are such as to enable me, by properly proportioning the spring 31, to provide an increased choking action if the throttle is suddenly opened when the engine is cold. That is, the pressure-drop within the intake manifold of the engine varies from around one inch of mercury during cranking with closed throttle or choke valve to about sixteen inches of mercury when the engine is self operative at low speeds and closed throttle. With the throttle 13 completely or nearly completely open, the pressure-drop in the manifold 10 will ordinarily not be less than five inches of mercury even at low engine speeds and will gradually increase as the engine speed increases.

If the spring 31 is so proportioned that it will

hold the piston 28 to the leftward end of its movement against a pressure drop of one inch of mercury in the intake manifold, will completely collapse and permit extreme rightward movement of the piston 28 when the pressure-drop within the manifold 10 is in the neighborhood of sixteen inches of mercury, and will undergo only a partial collapse when the pressure drop within the manifold is in the neighborhood of five inches of mercury, the result I desire will be accomplished. That is, during cranking, the piston 28 will be at the leftward limit of its movement thus producing its maximum effect in enrichening the mixture. When the engine starts to run under its own power, the piston 28 will move to the extreme rightward limit of its movement and will produce the minimum effect it is capable of exercising on the richness of the mixture. Should the throttle 13 be opened widely with the engine cold, the abrupt pressure drop within the manifold 10 will be insufficient completely to collapse the spring 31 but still sufficient to hold the piston 28 from reaching the extreme leftward limit of its movement, and thus my device will produce a slightly greater choking effect with the throttle wide open and the engine comparatively cold than it will with the throttle completely or nearly closed. As the engine-speed increases in response to the opened throttle, the pressure-drop will increase and the piston 28 will move to the right, tending to open the choke-valve and to decrease the richness of the mixture.

In Fig. 4 I have illustrated an embodiment of my invention in association with an automatic mixture-control device such as is set forth and described in my co-pending application Serial No. 532,376, filed April 23, 1930, now Patent No. 2,127,653. In that device, the choke-valve 14 is controlled by changes in the position of a movable member 50 which in turn is controlled by a temperature-responsive element 51 responsive to engine temperature and by an electro-magnet 52. In my co-pending application just referred to, the electro-magnet 52 is connected in parallel with the electric motor of the engine-starting device so that it is energized to draw the member 50 downward and move the choke valve 14 toward closed position whenever the engine-starting device is operative. The extent to which the choke-valve 14 is closed by energization of the magnet 52 and the extent to which it is opened after the magnet 52 is de-energized depend upon the position of the temperature-responsive element 51 which, through a movable member 53, adjusts stops 54 and 55 that limit closing and opening movements of the choke-valve 14 respectively.

In associating the invention of this application with the device just described, the magnet 52, instead of being arranged to be controlled by the starter-switch is connected to a battery 56 through the switch 57 that is usually employed to connect the battery to the engine ignition system, one part of which is indicated at 58. In series with the magnet 52, I place a pressure-responsive switch which is controlled by pressures in the intake manifold 10 of the engine. This switch may take different forms, the switch shown comprising a chamber 60 one side of which is defined by a movable diaphragm 61. The chamber 60 is in communication with the intake manifold 10 of the engine through a suitable tube 62. The diaphragm 61 carries a contact 63 which is grounded and which is arranged to engage a stationary contact 64 that is connected to one end of the winding of the electromagnet 52. The other end of the winding of the electromagnet 52 is connected through the ignition switch 57 to one terminal of the battery 56, and the other terminal of the battery is grounded.

In Fig. 4 the parts of the device just described are shown in the positions they occupy when the engine is comparatively cold and is not in operation. When the ignition switch 57 is closed preparatory to starting the engine, a circuit is completed from the battery 56 through the ignition switch 57, electromagnet 52, and contacts 64 and 63 to ground. The resulting energization of the electro-magnet 52 draws the member 50 downward to move the choke-valve 14 toward closed position, the extent of this movement of the choke-valve being limited by the position of the stop 54. The parts of the pressure-responsive switch are so arranged that the pressure within the intake manifold during the cranking operation is insufficient to move the contact 63 out of engagement with the contact 64; and as a result, the choke-valve, during the cranking operation, remains in the position it assumed when the magnet 52 was energized. As soon, however, as the engine begins to run under its own power, pressure within the intake manifold 10 drops, and the contact 63 is moved out of engagement with the stationary contact 64, thus interrupting the supply of current to the magnet 52 and permitting the choke-valve to move toward open position to an extent determined by the position of the stop 55. As the engine continues to run and its temperature increases, the stop 55 is moved upwardly under the control of the temperature-responsive element 51, until the choke-valve 14 reaches substantially wide open position when the engine reaches normal operating temperature.

I claim as my invention:

1. In combination with an internal combustion engine having a carburetor, an adjustable mixture-enriching device for said carburetor, a movable member, temperature-responsive means acting between said movable member and said device and nonresiliently connected to the latter, and means associated with the engine for moving said member in one direction when the engine is running and in the other direction when the engine stops.

2. A control mechanism for an internal combustion engine carbureter having a choke valve comprising, means for locking the valve closed to start the engine, means actuated by oil pressure in the engine for unlocking the valve, and a thermostat for controlling the opening of the valve as a function of temperature.

3. A control mechanism for an internal combustion engine carbureter having an unbalanced choke valve comprising, a lever connected to said valve, latch means engaging said lever to hold the valve closed for starting, oil pressure actuated means for moving said latch means to release the valve when the engine fires, a thermostat tensioned to hold the valve closed, and means for decreasing the tension of the thermostat when the engine fires to permit the valve to open under the control of the thermostat.

4. In an internal combustion engine having an intake manifold, a carbureter attached to said manifold, a pump driven by said engine, a device for controlling the richness of the fuel mixture supplied to said engine by said carbureter, a heat responsive device for controlling the operation of said mixture controlling device, and means responsive to pressure derived from said pump

for further controlling the operation of said mixture control device.

5. The invention set forth in claim 1 with the addition that said temperature-responsive means and movable member are located remote from said mixture-enriching device, a rigid link connected to said mixture-enriching device for operating it and extending into association with said temperature-responsive means, said temperature-responsive means serving to operatively interconnect said movable member and said link.

6. The invention set forth in claim 1 with the addition that said mixture-enriching device is an unbalanced choke valve located in the air-admission passage of the carburetor and tending to swing toward open position under the influence of the air impinging upon it.

7. In combination with an internal combustion engine having a carburetor, an adjustable mixture-enriching device for said carburetor, a movable member, temperature-responsive means acting between said movable member and said device and non-resiliently connected to the latter, said movable member being movable between two positions in the first of which it adjusts said mixture-enriching device to cause production of a relatively rich mixture and in the second of which it adjusts said mixture-enriching device to cause production of a relatively lean mixture, and means associated with said engine for controlling the position of said movable member and acting to maintain said movable member in said first position when the engine is being cranked and in said second positon when the engine is running under its own power.

GLEN R. SISSON.

CERTIFICATE OF CORRECTION.

Patent No. 2,309,419. January 26, 1943.

GLEN R. SISSON.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, first column, lines 3 and 12, for "claim 1" read --claim 7--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 23rd day of November, A. D. 1943.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.