Oct. 6, 1931. F. A. COLE 1,826,202

CARBURETOR

Filed April 12, 1930 2 Sheets-Sheet 1

Fig. 1.

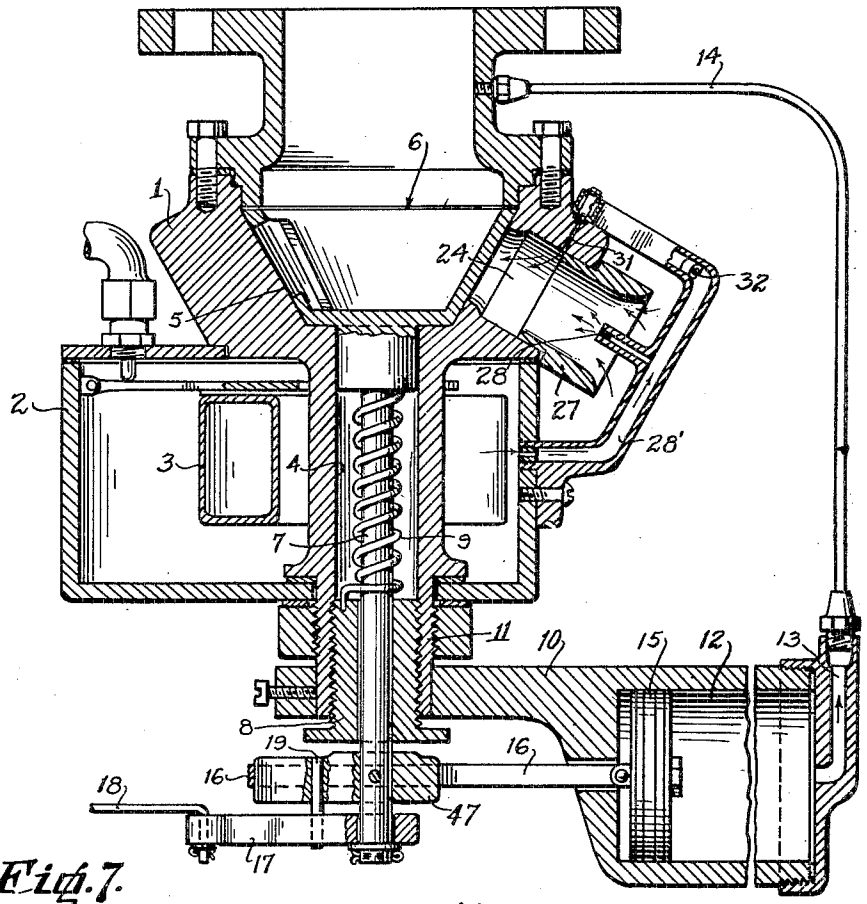
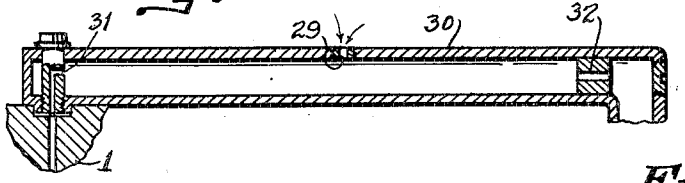


Fig. 7.



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Fig. 2.

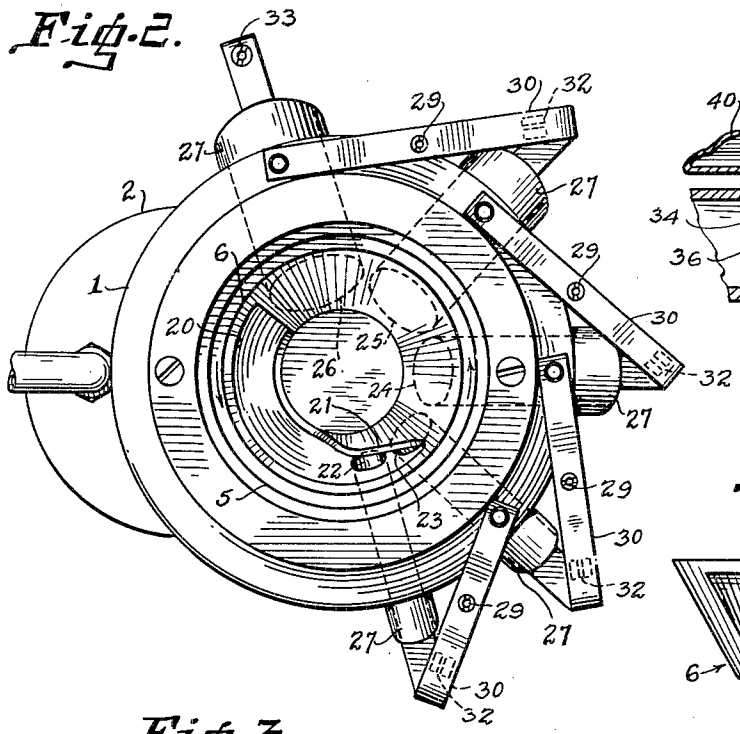


Fig. 6.

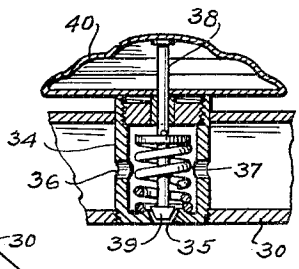


Fig. 5.

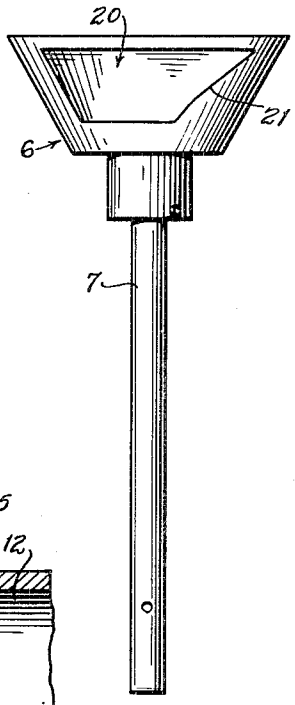


Fig. 3.

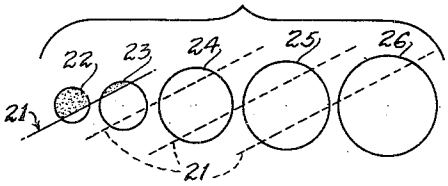
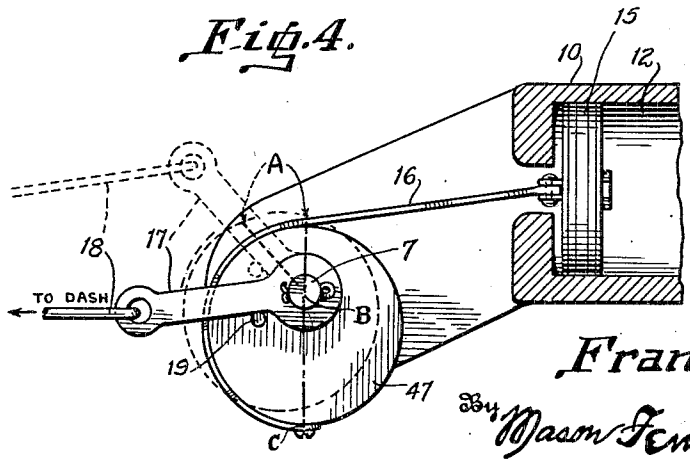


Fig. 4.



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Patented Oct. 6, 1931 1,826,202

UNITED STATES PATENT OFFICE

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CARBURETOR

Application filed April 12, 1930. Serial No. 443,820.

This invention relates to carburetors and has for its object the provision of a carburetor in which the throttle valve, in the accelerating phase of its cycle of oscillation is independent of the manual operating mechanism, to the extent that the manual operating mechanism does not directly actuate the throttle valve, but in any position to which said operating mechanism may be advanced, it forms a limit stop for the throttle valve, the movement of which limit stop, the throttle valve in its opening action closely trails, the throttle valve being directly actuated in automatic response to a function of the engine so that the mixture is fed in progressively increased amount, in exact quantity at any instant to meet the engine needs and not with arbitrary suddenness so as to cause "flat" spots in the engine operation, as ordinarily occurs when the throttle valve is opened at a rate which disregards the capacity of the engine to assimilate the admitted mixture.

Another object of the invention is to provide for the opening of the throttle valve responsive to engine suction, and to correlate this operation with the automatic proportion adjustment of the mixture, to compensate for falling vacuum as the opening movement progresses, so that at any engine speed and throughout all speed variations, the engine determines for itself the optimum mixture both in quantity and proportion.

A further object of the invention is to provide for a series of carburetting units progressively uncovered by the throttle valve and so disposed that before one is fully opened the next begins to be opened, whereby the successive accretions of the several units to the mixture supply will be effected in a continuous flow and not in distinct stages or impulses.

Still another object of the invention is to interlink certain mixture ingredient passages of the several carburetting units of the series so that weakening effect upon one unit produced by the opening of the next unit into the common immediate field of vacuum, will be, to the desired extent, compensated.

Another object of the invention is to provide a spring for assisting in closing the throttle valve, the tension of which spring naturally increases as the valve is opened, and compensating means for progressively nullifying the increment of the spring tension so that the load opposed by the spring to the vacuum which operates the throttle valve remains substantially constant throughout the working range of the carburetor.

Other objects of the invention will appear as the following description of a preferred and illustrative embodiment thereof proceeds.

In the drawings in which the same characters of reference are used throughout the several figures to denote the several parts:

Figure 1 is a vertical section through the carburetor embracing the principles of the present invention;

Figure 2 is a plan view of the same;

Figure 3 is a diagram showing the edge of the throttle valve port simultaneously cutting the inlet openings of adjacent carburetting units in the series of units;

Figure 4 is a bottom plan view partly in section showing the vacuum throttle valve actuating means and the means for compensating progressive increase in the closing-spring tension;

Figure 5 is a vertical elevation of the throttle valve per se;

Figure 6 is a cross-section through an atmospheric pressure controlled air inlet valve; and

Figure 7 is a longitudinal section through one of the interlinking conduits.

Referring now in detail to the several figures, the numeral 1 represents the body of the carburetor which in the present illustrative form is provided with a surrounding casing, 2 forming a float chamber and containing the usual float 3. The body is provided with a bore 4 which at the top is expanded into a frusto-conical depression 5 forming a seat for an oscillatory throttle valve 6, the head of which is of corresponding frusto-conical shape. The valve 6 has a stem 7 extending through the bore 4 and furnished intermediately with a guide 8 above which is a spring 9 housed within the

bore 4 and preferably surrounding the stem 7 with one end anchored to the valve and the other to the guide 8. The spring is so arranged that as the valve is opened, the tension of the spring increases and the function of the spring is to assist in closing the valve.

A fitting 10 is secured to the depending portion 11 of the body 1, said fitting being formed as a cylinder 12, which is in communication with the vacuum in the intake manifold by way of a passage 13 and a pipe 14. By means of this communication, vacuum conditions in the manifold are repeated in the cylinder. A piston 15 works in the cylinder 12, responsive to the vacuum therein, said piston being connected by convenient means such as the flexible strap 16 with an eccentric 47, the latter being secured in any suitable manner to the stem of the throttle valve. The strap 16 wraps about the periphery of the eccentric which is best shown in Figure 4, and it will be understood from Figure 4 that the leverage between the strap and eccentric is represented by the short radius A—B, and that as the piston moves out under the urge of the vacuum within the cylinder 12, this radius becomes longer and therefore, the leverage progressively increases. The value of this arrangement will be presently explained.

An arm 17 is journalled upon the lower end of the valve stem 7 and retained by any suitable means such as the washer and cotter pin shown in Figure 1. Said arm is connected by any suitable linkage 18 to the foot or manual control at the command of the driver of the engine. It will be understood that when the arm 17 is moved in the direction in which the throttle valve opens, it will have no direct effect in opening said valve but will freely rotate upon the valve stem. When the arm 17 is moved in a closing direction it abuts a pin or stop 19, projecting from the eccentric, and thus positively closes the throttle valve. It is this closing movement which is assisted by the spring 9.

Referring now to the throttle 6, and particularly to that showing of the valve in Figures 2 and 5, it will be noted that the valve has an elongated port 20, the advance edge 21 of which is inclined. Said throttle valve normally closes the outlet openings 22, 23, 24, 25 and 26 of a series of carburetting units and when the valve is moved to open position the inclined edge 21 of the port 20 first begins to uncover the opening 22 and then before the opening 22 is fully uncovered said edge begins to uncover the adjacent opening 23.

Figure 3 shows that there are common areas of the openings 22 and 23 uncovered at the same time and that before the opening 22 is entirely exposed, a considerable portion of the area of the adjacent opening is uncovered. The dotted lines in Figure 3 indicate that the same conditions prevail with respect to the other openings of the series of carburetting units.

Adverting to Figure 1 and interpreting this figure in connection with the plan view shown in Figure 2, it will be observed that the carburetting units each consist of a venturi 27, which may conveniently be made in the form of a plug and inserted in the opening 23. The outer end of this venturi is freely open to atmosphere. In the midst of the venturi a mixture nozzle 28 projects which is fed with liquid fuel through a passage 28′ communicating with the float chamber and with air admitted through an atmospheric orifice 29. When the throttle valve is moved so as to partially uncover the opening 23, suction in the manifold is communicated to the venturi drawing in a body of atmospheric air from the outer end of said venturi and at the same time entraining the mixture which emerges from the nozzle 28 in an atomized state, being thoroughly vaporized in the venturi, acting in accordance with known principles.

In the operation of the throttle valve, as it is moved still further in an opening direction it begins to uncover the opening 24 admitting some carburetted mixture through said opening into the common field of vacuum on the inside of said throttle valve, thus to an extent weakening the vacuum and decreasing its pulling power upon the carburetting unit represented by the opening 23. In order to compensate for this weakening in the vacuum whenever another unit in the series begins to be uncovered, the conduit 30 of each preceding unit is connected into the venturi of each succeeding unit so that when the second unit begins to be uncovered and an inward flow is set up through its venturi, there will be a pull upon the pipe 30 in the direction of the venturi of said succeeding unit, tending to reverse the direction of air flow in the pipe 30 and to rob the nozzle 28 of the preceding unit of some of the air ingredient of its mixture, thus enriching the mixture and in this manner compensating for the weakening of the vacuum to which said venturi responds.

As the vacuum conditions in the succeeding venturi improve, a still greater part of the air supply through the orifice 29 is diverted into the second venturi, still further enriching the mixture issuing from the preceding nozzle 28.

It has been stated that the opening of the throttle valve is not done by any manual or foot actuated means, but by vacuum conditions in the engine acting upon the piston 15 in the cylinder 12, and which in turn acts upon the valve stem through the eccentric 47. The arm 17 therefore, does not act as an opening instrumentality, but solely as a limit stop. If it is desired to speed up the engine, the

throttle valve is manually manipulated in the usual manner moving the arm 17 over in a clockwise direction as viewed in Figure 1, the engine speed accelerating in accordance with the degree of advance of the arm 17 and appearing to be a direct function of the amount of angularity of said arm. As a matter of fact, the movement of the arm 17 away from the stop 19 merely gives opportunity for the vacuum in the cylinder 12 to rotate the throttle valve by means of the eccentric 47, and against the spring 9, the throttle valve trailing the movement of the arm 17 so slightly as to give the impression that the two are mechanically connected. However, as a matter of fact, the throttle valve orients itself and thus brings into operation the successive carburetting units only just so fast as is demanded by the needs of the engine as evidenced by the vacuum condition in the cylinder 12.

Since the wider the throttle valve is opened the more the vacuum within the engine is satisfied by the admission of mixture and the weaker the vacuum becomes. It would therefore, be impractical to compel an ever weakening vacuum into the cylinder 12 to combat the increasing resistance of the spring 9 which becomes wound as the throttle valve is opened. The eccentric 47 which is intercalated between the valve stem 7, and strap 16 affords a compensating means, since the lever arm through which the strap 16 operates when the spring 9 is unwound, is the short radius A—B, while the length of this radius progressively increases as the throttle valve is opened and the spring 9 becomes wound until it reaches a maximum represented by the long radius B—C.

It is to be understood, referring to Figure 7, that the orifice 29, which supplies atmospheric air to the pipe 30 for the initial carburetion of the mixture in any one of the nozzles 28, should probably be larger than the orifice 31 through which air is diverted into the venturi of the carburetting unit, next succeeding. It is preferred to insert an orifice 32 between the atmospheric orifice 29 and the carburetting nozzle 28, but the size of this nozzle must be determined by experience. It is realized that when any succeeding venturi is pulling air from the pipe 30 of the preceding carburetting nozzle, the suction in said succeeding venturi is somewhat weakened, but its proportion to the amount of air entering the succeeding venturi directly from the atmospheric end of said venturi is so small that the additional air thus drawn in through the pipe 30 has a negligible effect.

The venturi associated with the first carburetting unit in the series of course, does not communicate with the air pipe 30 of any of the other carburetting units and the pipe 30 or its equivalent of its last carburetting unit of the series is opened by means of a mere bleed passage 33 to atmosphere.

One of the important features of the invention is that when the throttle valve has been set to a position for any desired speed of the engine and the piston is moving up under the urge of the vacuum in the cylinder 12 until the pin 19 abuts the arm 17 in its assumed position, the vacuum in the cylinder will remain substantially constant since the piston is in motion and its inertia is at a minimum. When the pin 19 finally abuts against the arm 17, the piston 15 will suddenly come to a rest resulting in a slight increase in the vacuum in the cylinder 12 but this has no important or undesirable result.

By a slight modification of the atmospheric orifice 29, the carburetor of the present invention may be particularly adapted for use on air craft. Figure 6 shows a modified form of atmospheric orifice to take the place of the atmospheric orifice 29. In this modification, a plug 34 is conveniently inserted within the pipe 30, said plug having an outer end open to atmosphere by way of a port 35.

The port 35 communicates by way of holes 36 and 37 in the plug 34 with the interior of the pipe 30. A spring opened valve 38 is provided within the plug 34 having a head 39 normally positioned to permit a normal flow of air into the plug and through the holes 36 and 37 into the pipe 30. Said valve is controlled by a diaphragm 40, responsive to atmospheric pressure. When the carburetor is taken to a high altitude the diaphragm 40 expands drawing up the valve 38 so that a greater space is left between the head 39 and the port 35, admitting a greater quantity of air. When a low altitude is encountered, the diaphragm is flattened, and brings the head 39 into minimum clearance with the walls of the pipe 30, thus reducing the quantity of air drawn in. In this manner, mixture proportions are maintained at an optimum value throughout all altitude ranges.

While I have in the above description endeavored to define what I believe to be a preferred and practical embodiment of the invention, it is to be understood that the details of construction as disclosed are by way of example only, and not to be considered as limitative in their bearing upon the scope of the invention as claimed.

What I claim is:

1. A carburetor comprising a series of throttle controlled carburetting units, each including a mixture nozzle communicating on the one hand with a source of liquid fuel and on the other hand having a passage communicating with an air source, venturis surrounding said nozzles, open at one end to the

atmosphere, a throttle valve controlling the opposite ends of said venturis, arranged to open them successively to a mixture chamber, said throttle valve having a port positioned so as to begin to open a venturi prior to its having fully opened the adjacent preceding venturi, the air passage of each mixture nozzle opening into the venturi of the next succeeding carburetting unit.

2. A carburetor comprising a series of carburetting units, each comprising a nozzle opening in the axis of a venturi, the latter being open at its outer end to atmosphere, a rotary throttle valve for placing said carburetting units successively into collective communication with a mixture chamber, and means controlled by the vacuum in the intake line between the throttle valve and engine for opening said throttle valve.

3 A carburetor comprising a series of throttle controlled carburetting units, each including a mixture nozzle communicating on the one hand with a source of liquid fuel and on the other hand having a passage communicating with an air source, venturis surrounding said nozzles, open at one end to the atmosphere, a throttle valve controlling the opposite ends of said venturis, arranged to open them successively and collectively to a mixture chamber, the air passsage of each mixture nozzle opening into the venturi of the next succeeding carburetting unit.

4. A carburetor comprising a series of throttle controlled carburetting units, each including a mixture nozzle communicating on the one hand with a source of liquid fuel and on the other hand having a passage communicating with an air source, venturis surrounding said nozzles, open at one end to the atmosphere, a throttle valve controlling the opposite ends of said venturis, arranged to open them successively and collectively to a mixture chamber, and means associated with all of the venturis except the first opened in the series for robbing the mixture nozzle of the preceding adjacent venturi of a portion of its air ingredient for enriching the mixture supplied to said preceding venturi in compensation of the weakening of the vacuum of said preceding venturi caused by the opening of said adjacent succeeding venturi into the common field of vacuum on the manifold side of said throttle valve.

5. A carburetor comprising a series of carburetting units, a rotary throttle valve for placing said carburetting units successively into collective communication with a mixture chamber, means controlled by the vacuum in the intake line between the throttle valve and engine for opening said throttle valve, a spring closing said throttle valve, and means between said vacuum controlled means and throttle valve for compensating the increased tension of said spring as said throttle valve is progressively opened.

6. A carburetor comprising a series of carburetting units, a rotary throttle valve for placing said carburetting units successively into collective communication with a mixture chamber, means controlled by the vacuum in the intake line between the throttle valve and engine for opening said throttle valve, a spring closing said throttle valve, and means between said vacuum controlled means and throttle valve for compensating the increased tension of said spring as said throttle valve is progressively opened, said means including an eccentric secured axially to said throttle valve, and a strap connected to said eccentric and said vacuum controlled means and wound about the periphery of said eccentric, for lengthening the lever arm constituted by the radius of said eccentric to which at any moment the straight portion of said strap is tangent, proportionate to the simultaneous increment in the tension of said closing spring.

7. A carburetor comprising a series of throttle controlled carburetting units, each including a mixture nozzle communicating on the one hand with a source of liquid fuel and on the other hand having a passage communicating with an air source, venturis surrounding said nozzles, open at one end to the atmosphere, a throttle valve controlling the opposite ends of said venturis, arranged to open them successively and collectively to a mixture chamber, the air passage of each mixture nozzle opening into the venturi of the next succeeding carburetting unit, whereby when the said succeeding carburetting unit is opened, the mixture nozzle of the adjacent preceding carburetting unit is robbed of a portion of its air constituent, enriching the mixture from said mixture nozzle to compensate for weakening of the vacuum of said preceding venturi due to the opening of the venturi of the said succeeding carburetting unit into the common vacuum field on the engine side of said throttle valve, and an atmospheric air inlet into said air passage between the mixture nozzle of the preceding carburetting unit and the venturi of the succeeding carburetting unit.

8. A carburetor as claimed in claim 7, including an atmospheric pressure responsive valve controlling said atmospheric air inlet.

In testimony whereof I affix my signature.

FRANK A. COLE.