March 9, 1926. 1,575,877

P. S. TICE

CARBURETOR

Original Filed April 9, 1920 2 Sheets-Sheet 1

Fig. 1.

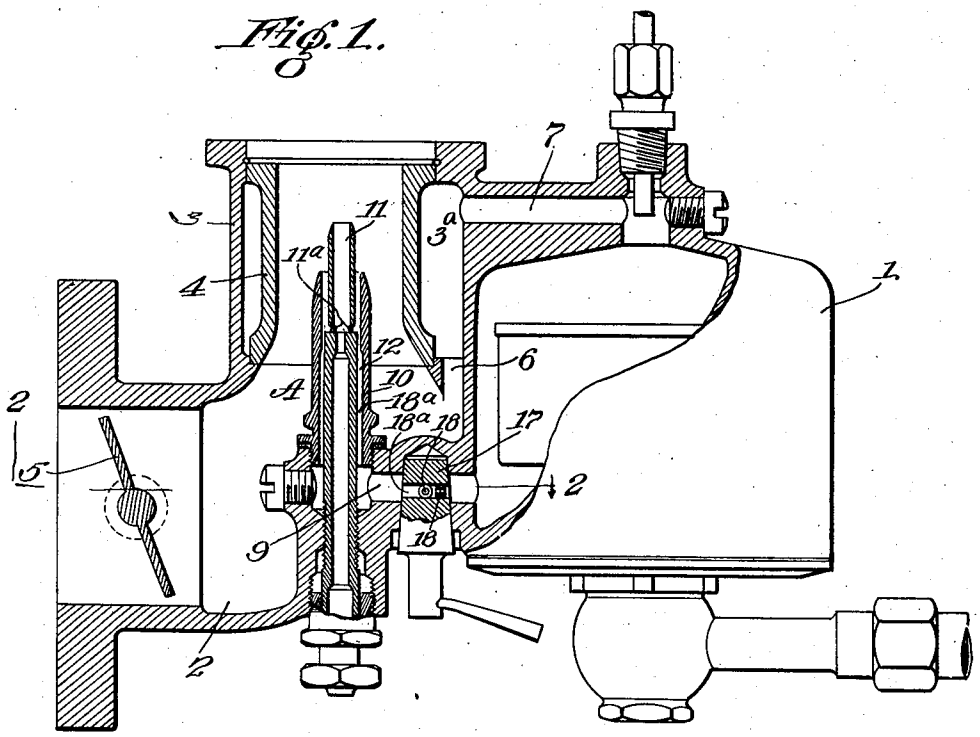
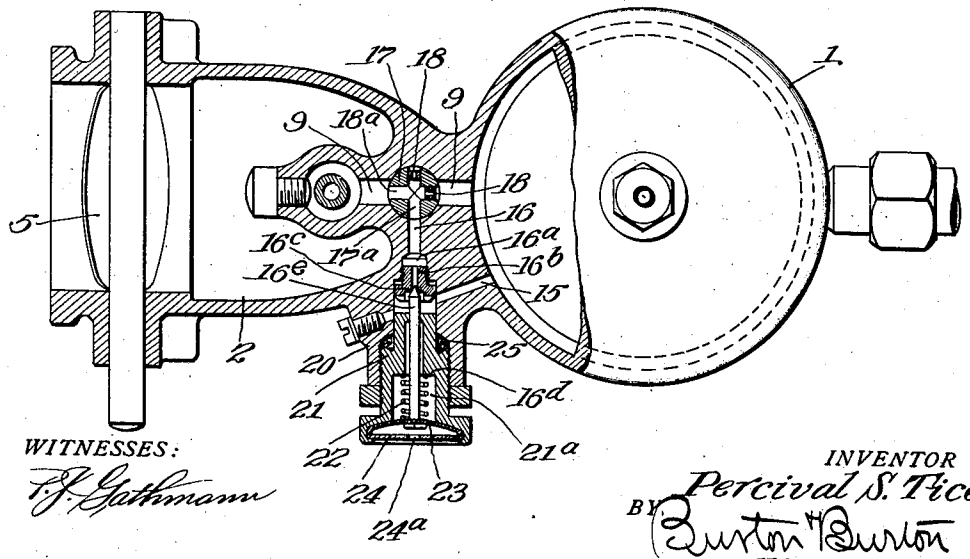


Fig. 2.



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Fig. 3.

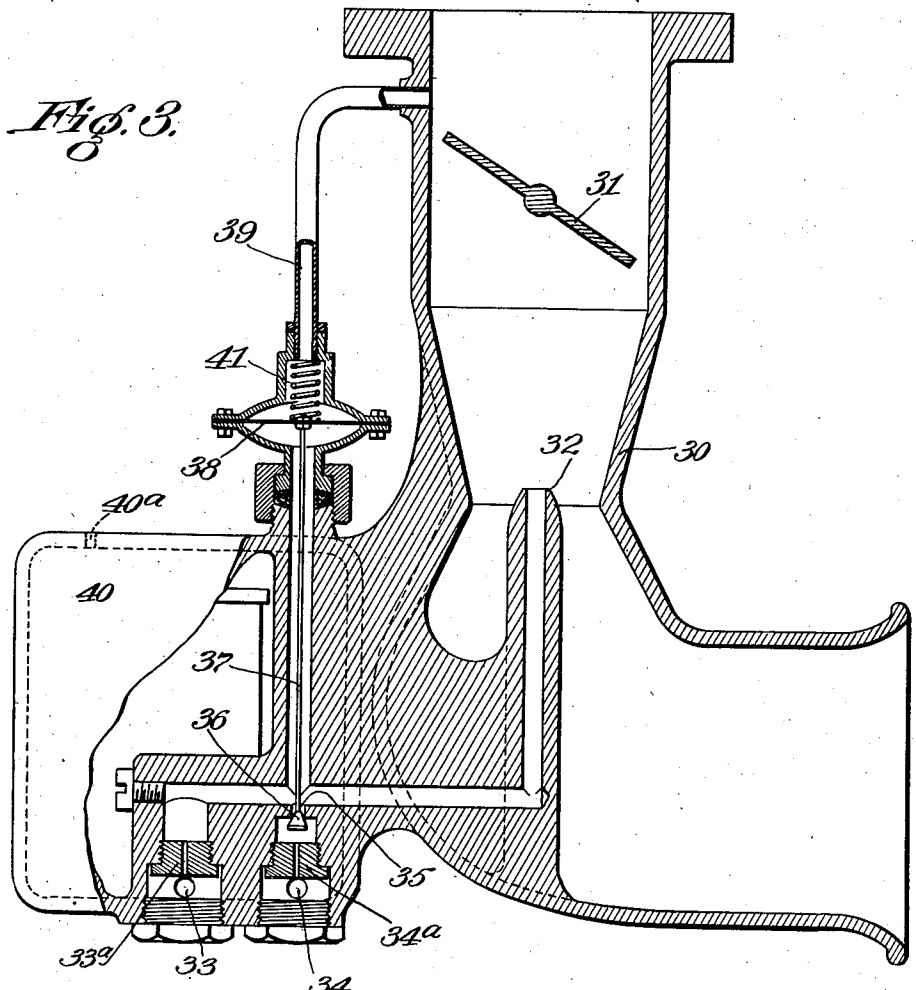
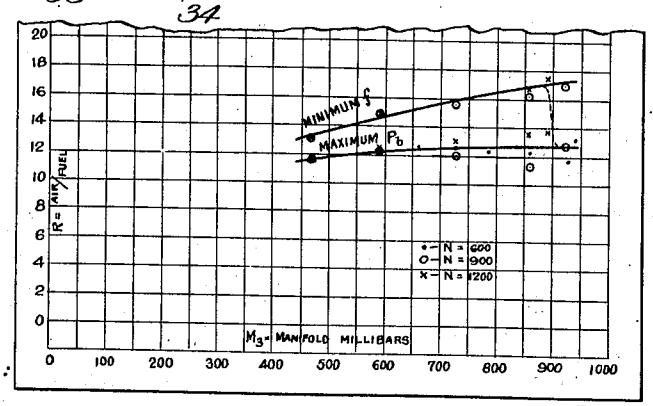


Fig. 4.



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Patented Mar. 9, 1926. 1,575,877

UNITED STATES PATENT OFFICE.

PERCIVAL S. TICE, OF CHICAGO, ILLINOIS.

CARBURETOR.

Application filed April 9, 1920, Serial No. 372,384. Renewed August 5, 1925.

To all whom it may concern:

Be it known that I, PERCIVAL S. TICE, a citizen of the United States, residing at Chicago, in the county of Cook and the State of Illinois, have invented certain new and useful Improvements in Carburetors, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

The purpose of this invention is to provide an improved construction of carburetors for internal combustion engines designed for the purpose of enabling their operation ordinarily with maximum fuel economy, and also enable the operator to obtain from the engine when required the maximum output of which it is capable. It consists in the elements and features of construction shown and described, as indicated in the claims.

In the drawings:

Figure 1 is a partly sectional side elevation of a carburetor embodying this invention, the casing being partly broken away, and the operating parts being shown in vertical section axial with respect to the air passages.

Figure 2 is a section at the line 2—2, on Figure 1.

Figure 3 is a view similar to Figure 1, showing the invention applied to a different form of carburetor.

Figure 4 is a diagram showing the curves of maximum economy and maximum power output, in comparison.

Figure 5 is a section of a portion of the structure shown in Figure 3, showing a valve which controls a supplemental fuel inlet and a diaphragm which controls the valve, in different positions from those shown in Figure 3.

In the operation of a throttle-controlled internal combustion engine, the proper mixture—that is, the proper ratio of fuel to air—for maximum economy, i. e., for giving minimum fuel consumption per horse-power hour, is not constant with varying load or work done. On the contrary, as the work to be done changes, not only must the quantity of mixture change, but also the quality or richness must change in order to perform each different degree of work with maximum economy of fuel.

But the maximum power derivable from a given engine, is not obtainable with the air and fuel ratio which is required for maximum fuel economy; and when the maximum power output is needed, means must be employed to increase the fuel supply beyond the economical ratio for which the fuel-and-air-determining devices are normally constructed or adjusted.

Likewise, if the construction or normal adjustment of the carburetor is such as to permit the development of maximum power, maximum fuel economy will not be obtained at any point in its operation.

The fundamental-mixture ratio requirement for the development of maximum power and maximum economy respectively, in an engine, are shown graphically in Figure 4 which is developed from tests of several representative engines and may be understood from the markings on said figures. The upper curve defines the ratios of air to fuel which result in least fuel consumption in pounds per horse-power per hour; and the lower curve defines the ratios which result in maximum power development.

Since the possible power development of an engine varies directly with the weight of air aspirated, and since this quantity varies directly with the pressure in the intake manifold or pipe, the possible power output varies directly as the pressure in the intake pipe.

Since this utmost power can be developed only when the intake pipe pressure is at its maximum—that is, when the throttling is at minimum—it is clear that a great saving in fuel will result if the mixture-controlling devices are normally adjusted for maxmum economy of fuel, and the mixture is enriched to that which gives maximum power only when the manifold pressure is maximum—that is, when the throttling is at the minimum.

This special enrichment of the mixture cannot prudently be left to the operator of the engine, because it would require the exercise of acutely trained judgment and most critical attention to, and ability to estimate, the work and power requirements from minute to minute, and also unfailing memory for restoring the fuel intake adjustment of the nozzle, as soon as the exigency calling for maximum power output is past; and the object of the present apparatus is to permit automatically shifting from the economical range of mixtures to that giving maximum power output, only

when the throttle is fully or almost fully open. This will be accomplished if the ratio of air to fuel can be automatically dropped quickly from the point shown on the upper of the two graphs on Figure 4 marked "Minimum *f*," denoting minimum fuel to the point shown on the lower graph marked "maximum, P*b*," denoting maximum power development as the manifold pressure approaches maximum, as for example, as indicated by the circumflex dotted line, C^r, connecting a point on the upper graph, at which the change of ratios may be assumed to begin, with a point on the lower graph at which the change is assumed to be completed for giving maximum power development. The notation on Figure 4, ". — N=600, O — N=900, X — N=1200" indicates that on the point on the graphs marked . , the number of revolutions per minute is 600; at the point marked O the number of revolutions is 900 per minute, and at the point marked X, the number of revolutions is 1200 per minute.

The device is shown in Figures 1 and 2 as applied to a carburetor of a special type which is shown in my patent No. 1,300,517 dated April 15, 1919, but it is not limited in its applicability to this type of carburetor; and in Figure 3 it is shown applied to a more common type of carburetor which is shown somewhat conventionally. Describing the device as shown in Figures 1 and 2:—The carburetor body comprises a float chamber, 1, and integral with it the air intake passage 2—3, of angle form, comprising the inlet-end member, 2, and the member, 3, which is designed to be connected with the intake manifold of the engine, (not shown). In the member, 3, there is mounted a mixing sleeve, 4, having a tapered entrance. The throttle valve, 5, is mounted in the inlet end of the intake passage. The intake passage has communication from a point back from the venturi, 4, with the top of the float chamber by means of a passage, 6, opening into the annular passage, 3^a, which extends up alongside the mixing sleeve, 4, forming a lateral extension at that side of the sleeve of the annular passage, 4^a, which extends around the sleeve, said passage, 3^a, communicating with the horizontal passage, 7, above the float chamber which opens downward into the float chamber. The ordinary or normal fuel delivery passage from the float chamber, is seen at 9, leading to the nozzle, A, which comprises an outer member, 10, an air inlet tube between which and the outer member, 10, there is an annular passage, 12, for the liquid fuel which is drawn in through ports, 11^a, into the inner tube, 11, and aspirated by the air drawn in through said tube, the aspirated mixture being delivered from the upper end of said tube, 11. This nozzle which is fully shown and described in my Patent No. 1,300,517, dated April 15, 1919, does not constitute a part of the present invention, any other type of nozzle being permissible in conjunction with the features of the invention which are yet to be described. From the float chamber, in addition to the fuel delivery pipe, there is provided an additional fuel duct, 15—16, which intersects and connects with the duct, 9, at a point anterior to the communication of said duct with the nozzle passage 12. At the intersection of said ordinary and auxiliary duct there is provided a turn-cock member, 17, having intersection passages, 17^a, 18^a, for registering respectively with the ducts, 9 and 16. 18, 18, are plugs which are mounted in the passages, 17^a and 18^a, respectively, having relatively small orifices for restricting the fuel flow through the duct, 9. Said orifices are of different diameters adapted for fuels of different viscosity, the plug being turned to bring one or the other of the passages, 17^a or 18^a, into service for fuel flow to the duct, 9.

The auxiliary fuel supply ducts, 15, 16, are arranged as shown at an angle to each other for convenience of introducing a valve to control the flow through said auxiliary passage, and for admitting the pressure of the fuel intake passage,—which is substantially the engine manifold pressure or a direct function thereof,—to a device for governing the said valve. For accommodating such valve and its governing devices the carburetor body has a boss, 20, which is drilled at two intersecting lines to produce the auxiliary duct parts, 15 and 16, the initial portion of the bore for the part, 15, being closed by a plug, and the bore for the part, 16, being counterbored from the outer end to receive a flow restricting plug, 16^b. At the outer end this plug, 16^b, affords a valve seat 16^c, for the valve 16^e and outside of said plug, 16^b, the boss, 20 is further counterbored to receive a plug, 21, which is axially bored to accommodate the stem of the valve, 16^e, and counterbored at 21^a, to accommodate a spring, 22, stopped between the shoulder, 16^d, of the last mentioned counterbore and a diaphragm, 23, which is secured at the end of the valve stem, 16^e, said spring occupying the chamber formed by the last mentioned counterbore. The diaphragm is secured and retained in place by a closure plate, 24, which has an aperture, 24^a, adapted to admit atmospheric pressure to the outer side of said diaphragm. 25 represents packing interposed at the inner end of the chambered plug, 21, to prevent air leak around said part, and insure the transmission around the valve stem to the inner side of the diaphragm, of the pressure operating on the liquid in the float chamber. It will

be understood that the absolute pressure existing in the engine intake manifold, or a direct function thereof existing in the intake passage beyond the throttle valve, is transmitted through the passages, 6 and 7, to the upper part of the float chamber; and that this pressure will operate through the duct, 15, and the passage, 21, around the valve stem, 16e, on the inner side of the diaphragm, 24, opposing atmospheric pressure which operates upon the outer side of the diaphragm. And it will be understood that so long as atmospheric pressure exceeds the sum of the resistance afforded by the spring, 22, and the less-than-atmospheric pressure operating upon the liquid in the float chamber, the valve, 16e, will be held seated, and no liquid will pass through the auxiliary passage, 15—16; so that under these conditions the carburetor will receive its supply of liquid fuel only through the ordinary passage, 9. But, when as in the case of wide-open throttle, the pressure in the manifold becomes nearly atmospheric,—that is, the vacuum is reduced to a minimum,—the sum of the force exerted by the spring, 22, and this nearly atmospheric pressure in the float chamber, will exceed the atmospheric pressure operating on the outer side of the diaphragm, and will force the valve open, thereby admitting an auxiliary supply of fuel through the auxiliary passage, 15—16, to be added to that which is derived through the duct, 9. By properly relating the tension of the spring, 22, to the area of the diaphragm, 23, the stage of pressure in the engine intake manifold at which the valve, 16e, will be opened in the manner described, may be made substantially that which results from wide open throttle; and thereby the auxiliary supply of fuel will be added to the ordinary supply only after the power output of the engine has first reached the maximum obtainable with maximum fuel economy; so that the richer and less economical mixture will be afforded only when it is necessary for the purpose of maximum power output.

It will be understood that the full line position of the valves, 16e, in Figure 2, and 36 in Figure 3,—seated,—corresponds to the full line position of throttles 5 and 21, in Figures 1 and 3, respectively, when the engine is running. When the engine comes to rest the diaphragm and valves assume the dotted line positions shown in Figures 1 and 3 respectively, regardless of the position of the throttle.

Maximum intake manifold pressure is above referred to as resulting from and corresponding to maximum throttle opening; but this is not entirely correct, because when the engine is running at slow speed by reason of heavy load, the intake manifold pressure may approximate atmospheric pressure with the throttle open one-half or less. And it is the purpose and the merit of the device hereinabove described, that whenever the manifold pressure approximates atmospheric pressure to the degree predetermined by the adjustment of the tension of the spring, 22, to the area of the diaphragm, 24, whether this approximation results from wide open throttle or from low engine speed, the valve, 16e, will be open and a richer mixture afforded for increasing the power output of the engine.

In the form shown in Figure 3, comprising the Venturi throat member, 30, the throttle valve, 31, is located beyond the fuel discharge nozzle, 32; and said fuel discharge nozzle has communication with the float chamber for supply of fuel thereto through two passages, 33 and 34, each provided with a metering plug,—33a and 34a, respectively,—33 being the ordinary supply passage and 34 the auxiliary supply passage, the communication of the latter with the former at the port, 35, being controlled by a valve, 36, having its stem, 37, operatively connected with the diaphragm, 38, which is exposed on one side to the pressure operative in the float chamber, which in this type of carburetor is atmospheric pressure admitted through the atmosphere vent aperture 40a, and at the opposite side to the intake passage pressure derived through a pipe 39, leading from the intake passage at a point beyond the throttle valve, 31, the spring, 41, being provided to react upon the diaphragm at the same side thereof as the intake passage pressure derived from the pipe, 39. In this structure as in that first described, the tension of the spring, 41, will be adjusted to the area of the diaphragm, 38, so as to cause the valve, 36, to be held seated until the pressure in the intake passage beyond the throttle valve, 31, approximates atmospheric pressure, which will happen when the throttle valve is wide open, or when, the throttle valve being partly open, the engine speed declines by reason of heavy load. And it will be seen that the principle and mode of operation of the structure shown in Figure 3 is the same as that described in Figures 1 and 2.

I claim:—

1. In a carburetor in combination with an air intake passage, a fuel discharge passage discharging within the air intake passage; means for throttling the air intake passage; a supplemental fuel supply passage; a valve which controls it; an expansible and contractible chamber having a wall which moves in the expansion and contraction of the chamber; a pressure duct leading from a point in the air intake passage beyond the throttling valve for communicating pressure to said expansible and contractible chambers, the moving wall being locat-

ed for operating said valve upon change of pressure in the chamber beyond a predetermined degree.

2. In the construction defined in claim 1, foregoing, a spring reacting upon the movable chamber wall in a direction for opening the valve.

3. In a construction defined in claim 1, the expansible and contractible chamber being in liquid communication with the fuel supply chamber of the carburetor; and said chamber being in communication at the upper part with the intake passage; whereby the pressure communication from the intake passage to said expansible and contractible chamber is effected through and by means of the liquid fuel in the fuel supply chamber.

4. A carburetor having in combination with a main air intake passage and means for throttling it, a fuel discharge passage discharging within the air intake passage; a supplemental fuel supply passage; a valve controlling said supplemental fuel supply passage, and means operated by the pressure in the intake passage inwardly beyond the throttling means for controlling said valve.

In testimony whereof, I have hereunto set my hand at Chicago, Illinois, this 5th day of April, 1920.

PERCIVAL S. TICE.