May 29, 1923. 1,456,502

A. E. HARTWELL

CARBURETOR FOR INTERNAL COMBUSTION ENGINES

Filed Feb. 12, 1919 2 Sheets-Sheet 1

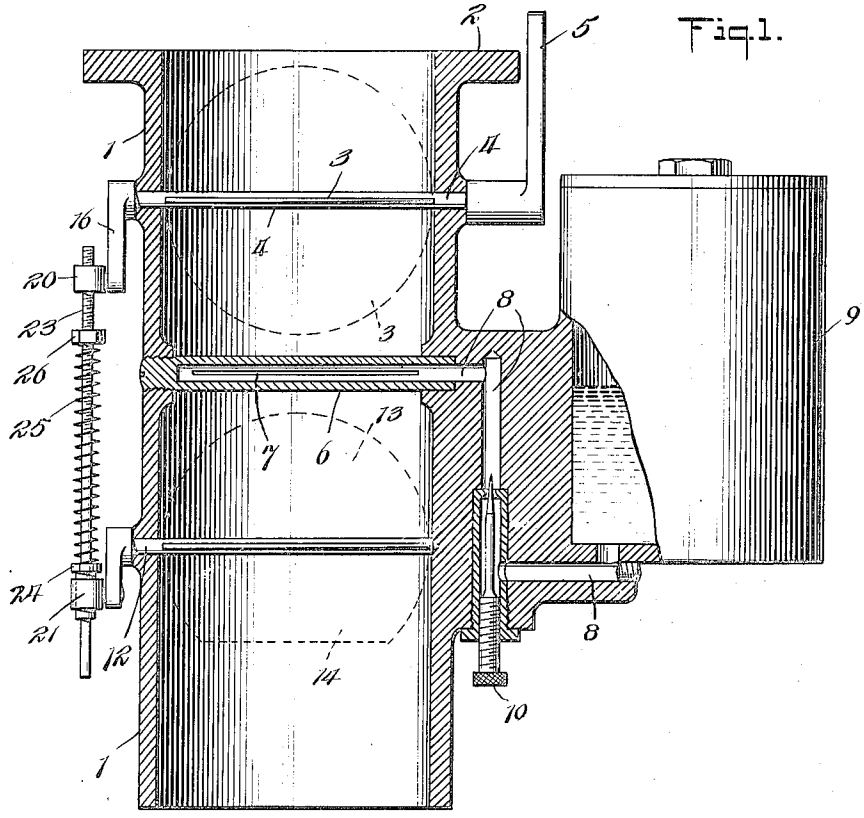


Fig. 1.

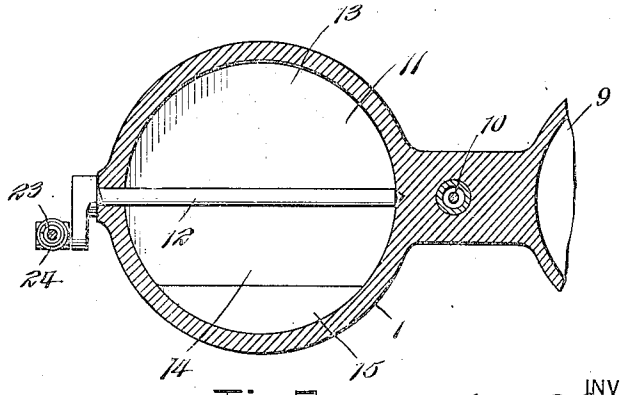


Fig. 2.

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Fig.3.

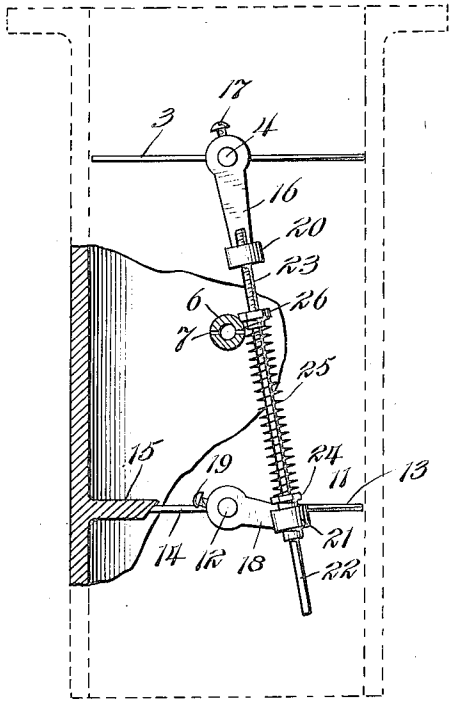
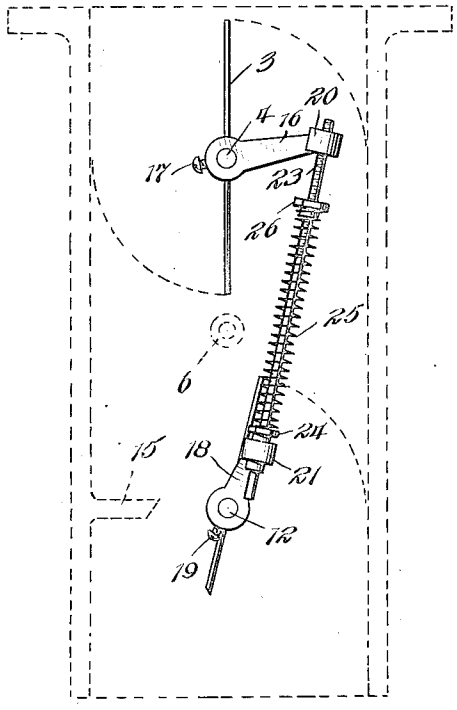


Fig.4.



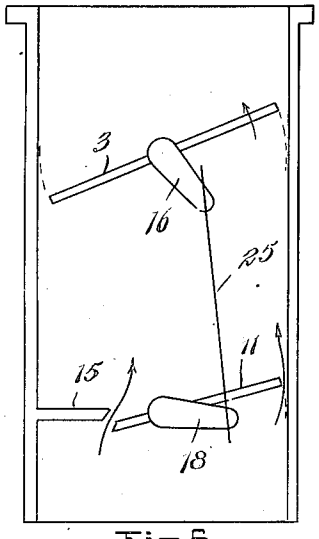


Fig.5.

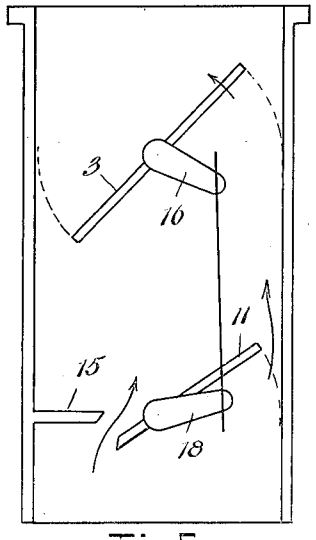


Fig.6.

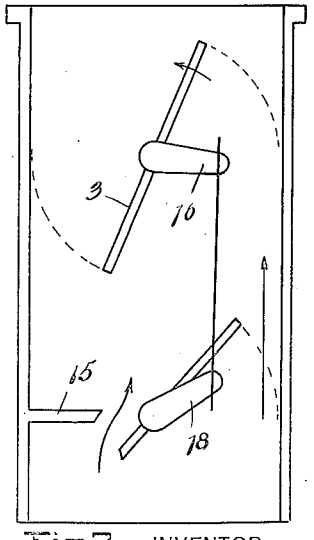


Fig.7.

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Patented May 29, 1923. 1,456,502

UNITED STATES PATENT OFFICE.

ALBERT E. HARTWELL, OF NEWARK, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO AUTO BETTERMENT CORPORATION, OF NEWARK, NEW JERSEY, A CORPORATION OF DELAWARE.

CARBURETOR FOR INTERNAL-COMBUSTION ENGINES.

Application filed February 12, 1919. Serial No. 276,471.

To all whom it may concern:

Be it known that I, ALBERT E. HARTWELL, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Carburetors for Internal-Combustion Engines, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

The general object of the invention is to provide an instrument of great simplicity for effectively atomizing and mixing liquid fuel with air in very close approximation to correct proportion under various operating conditions. A further object is to provide means in addition to the usual throttle for automatically controlling the degree of vacuum in the mixing space with regard to both the throttle position and the engine speed.

These objects are accomplished in a preferred form of my invention by delivering the fuel through a nozzle which is usually in the form of a slit in a fuel pipe extending across the air passage and directed substantially at a right angle to the flow of air; and preferably two of such nozzles oppositely located in the fuel pipe are provided. The air passing through the mixing space comes directly in contact with the fuel at the orifices of these nozzles and removes the fuel by direct contact or adhesion in addition to the injecting action of the fuel caused by the degree of vacuum existing at the moment in the mixing space; and this removal of the fuel is not affected by any localized vacuum areas or eddies in the air flow, as is the case with many fuel apertures or nozzles otherwise arranged. This mode of delivering the fuel to the air produces a very complete and effective atomization of the fuel.

In combination with such a fuel nozzle or nozzles, or other suitable fuel delivery, means, and in connection with the ordinary throttle, I provide a device acting upon the air column anterior to the fuel nozzle to control or regulate the degree of vacuum between that device and the throttle, or, in other words, in the mixing space containing the fuel nozzle, and this regulating device is interconnected with the throttle by suitable means, so that the regulation is automatic and results in the delivery to the air column of a remarkably constant proportion of fuel under varying conditions. More particularly described, the regulating means comprises a choking or throttling device which may be of butterfly form suitably unbalanced and arranged, so that the air stream tends to open it, and this is connected through suitable arms, a link and a spring with the stem of the throttle; and these parts are arranged in one preferred form so that in the different positions of the throttle the effect of the spring upon the regulating device varies in ways and for reasons which will be explained.

The accompanying drawings show one physical embodiment of the invention, and after considering this in connection with the description, it will be evident to persons skilled in the art that the invention may be embodied in different forms, and I do not limit myself to details except as claimed.

Fig. 1 is a view mainly in vertical longitudinal section of a carburetor embodying the invention.

Fig. 2 is a horizontal section substantially in the plane of the stem of the regulating valve.

Fig. 3 is a side elevation of the throttle regulating valve and connection, other parts of the instrument being shown in section and in dotted lines for the sake of clearness.

Fig. 4 is a similar view with the parts in another operative position.

Figs. 5, 6 and 7 are diagrammatic views of substantially the same mechanism in different operative positions.

The instrument comprises a tubular body 1 providing an air passage and terminating at its upper end in the usual flange 2 for connection to the intake manifold. The shape of the air passage may be varied considerably, but its major portion may, as shown, be, in a satisfactory form of the instrument, a substantially straight cylinder. Near the upper end of the body is a butterfly throttle 3 having its stem 4 oscillatably mounted in the walls of the body and provided with the usual arm 5 to be connected to the usual controlling devices.

At a convenient distance below the throttle is a fuel tube 6 which is arranged trans-

versely of the air passage. At opposite sides of the fuel tube and usually in the exact horizontal diametral plane of the tube, fuel slits or nozzles 7 are provided, these usually being very thin. The width of the nozzles is somewhat exaggerated in the drawings for the sake of clearness. Usually, the slits extend approximately throughout the width of the air passage, as indicated in Fig. 1.

Other forms of fuel supply devices may be used in some cases, but when a transversely located fuel tube is used, as shown, it serves to decrease somewhat the area of the air passage at the fuel nozzles and the consequent increase in velocity of the air at this point assists in the eduction and proper atomization of the fuel.

Fuel is supplied to the tube 6 in any suitable way—in this case by suitable passages 8 leading to a float chamber 9; and a needle valve 10 is usually provided to regulate the maximum flow to the tube.

Below the fuel tube is located the regulating device, consisting in this embodiment of a modified "butterfly" 11; that is, a device resembling the usual butterfly throttle, with modifications. The stem 12 of the regulator is oscillatably mounted in the walls of the body 1 and the portion 13 of the regulator at one side of the stem is left in full semi-circular form while the portion 14 at the other side of the stem is cut away on the line of a sector of the circle, usually parallel to the stem, so that the regulating valve is unbalanced and so that the edge of the part 14 fits when the device is closed against the suitably formed edge of a member 15 secured in the air passage, usually by forming it as a part of the body 1. One function of this member is to cooperate with the regulator 14 in closing the air passage at times and in maintaining the proper area of air opening below the fuel nozzles in cooperation with the regulator at other times, and the member 15 also functions as a choking or air retarding device at times.

To connect the regulator with the throttle for the purpose in view, the throttle stem is provided with an arm 16 secured by a set screw 17, and the regulator stem 12 is provided with an arm 18 secured by a set screw 19. The arm 16 has a small lug 20 swiveled upon it and the arm 18 has a similar lug 21 similarly mounted. A connecting stem or link 22 is arranged to pass through these lugs and is screw threaded at 23 so as to be positively secured to the lug 20. The stem passes movably through lug 21, and conveniently the lug may be provided with a sleeve bushing 24 to accommodate the stem. A helical spring 25 is located on the stem and bears at one end against the bushing 24 and at the other against a nut 26 adjustably located on the screw thread 23 of the steam.

The arms 16 and 18 may be differently set on the stems 4 and 12 by means of the set screws 17 and 19, so that the angles of the arms in respect to the butterfly members 3 and 11 may be varied for different purposes. One preferred adjustment of the arms is shown in Figs. 3 to 7 in which the arm 16 is at an angle of nearly 90°—preferably somewhat less—to the throttle, and the arm 18 is set at a slight angle to the regulator 11, although nearly parallel with it.

With this adjustment, when the throttle is closed, as shown in Fig. 3, arm 16 points almost directly downward, arm 18 is almost horizontal, and spring 25 is compressed with suitable tension, which may be regulated within reasonable limits by the nut 26, thus holding the regulator closed with the edge of its part 14 against the ledge 15, thus completely closing the air passage below the fuel nozzles.

Fig. 3 shows both the throttle and regulating valve closed and the spring 25 may be adjusted so that when the throttle is moderately opened for starting the engine the regulating valve will still be held closed by the spring until the engine starts. Fig. 5 shows the throttle moderately opened for starting. As soon as the engine starts the movement of air induced by piston movement opens the regulating valve against its spring substantially as shown in this figure. At this time the spring 25, due to the angular relation of arms 16 and 18, exerts nearly its full effect to resist opening movement of the regulating valve and, therefore, at the moment of starting a strong "vacuum" is created in the mixing space comprised between the regulator 11 and the throttle 3, and an ample supply of fuel is thus drawn from the nozzles for easy starting. The pressure of air below the regulator acting on its larger side 13 opens the regulating valve against the spring to an extent regulated by the spring balanced against the air pressure. Fig. 5 shows the throttle opened moderately for ordinary running. This may in some cases be the same throttle position that is used in starting the engine. If the load on the engine is light, the engine runs relatively fast, inducing more air to pass through the carburetor and tending to create a relatively high degree of vacuum in the mixing space, and in this case the action of atmospheric pressure below the regulator causes it to open rather more than shown in Fig. 5 to admit the suitable amount of air and at the same time to induce the delivery of a suitable proportion of fuel for this condition of running. If the load on the engine increases the engine slows down; less air passes through the instrument; the regulator closes proportionately to about the position shown in Fig. 5; the

proper "pull" is at the same time kept on the fuel by the automatic action of the regulator, and the proper amount of fuel in proportion to the reduced amount of air is delivered. Figs. 6 and 7 show progressively greater openings of the throttle and also show how, as the throttle opening increases, the angularity of arms 16 and 18 in respect to each other and in respect to their throttle and regulating valve respectively, change, so that the effective action of the spring is relatively greater in the more nearly closed positions and relatively less in the more nearly open positions until, as shown in Fig. 4 where the throttle is completely open, arm 18 is almost parallel with the spring and the spring exerts a minimum effect in opposition to the opening movement of the regulating valve. The nut 26 may be adjusted in some cases so that, in the position of Fig. 4, there is practically no spring pressure against the regulating valve when it is closed, but as the valve opens, spring pressure is applied, but with moderate effect due to the angularity of arm 18. The result of this arrangement is that in full open throttle position with the engine running fast there is practically no impedance of air by the regulator and the only vacuum effect tending to eject fuel from the nozzles is that supplied by air friction in the passages below the nozzle and by any restriction in the form of such passages, including, of course, in this embodiment the ledge or chocker 15. When the load increases so that the engine slows down and less air passes through the instrument, the regulating valve closes proportionately and maintains the vacuum in the mixing space in proper degree to provide the slightly richer proportion of fuel to air which is desirable in this case.

The action of the instrument in other intermediate positions can be understood from the previous explanation and a careful study of the structure.

The fuel nozzles 7 extend straight across the middle of the air stream, and air passing at each side of the fuel tube 6 is directed in close contact with the fuel orifices, so that the fuel mixes thoroughly with the air and completely vaporizes, or if the fuel is of such quality that it will not actually vaporize at the temperature existing in the instrument or in the manifold, it will remain in the air in particles in suspension with relatively small tendency to condense or collect upon the walls.

What is claimed is:

1. In a carburetor, the combination of a body providing an air passage, a throttle therein, a fuel nozzle in the passage below the throttle, an unbalanced regulating valve located in the passage below the nozzle and arranged to be opened by entering air, an arm connected to the throttle, an arm connected to the valve, a link connecting the arms and movable in respect to one of them, and a spring carried by the link opposing variable resistance to the opening movement of the valve.

2. In a carburetor, the combination of a body providing an air passage, a throttle therein, a fuel nozzle in the passage below the throttle, an unbalanced regulating valve located in the passage below the nozzle and arranged to be opened by entering air, an arm connected to the throttle, an arm connected to the valve, a link connecting the arms and movable in respect to one of them, a spring carried by the link opposing variable resistance to the opening movement of the valve, and means for adjusting the angular position of one of said arms.

3. In a carburetor, the combination of a body providing an air passage, a throttle therein, a fuel nozzle in the passage below the throttle, an unbalanced regulating valve located in the passage below the nozzle and arranged to be opened by entering air, an arm connected to the throttle, an arm connected to the valve, a link connecting the arms and movable in respect to one of them, a spring carried by the link opposing variable resistance to the opening movement of the valve, means for adjusting the angular position of said arms in relation to the throttle and valve respectively, and means for adjusting the effective tension of said spring.

4. A carburetor comprising a body having an air passage including a mixing space, a fuel conduit having an orifice in the mixing space, an oscillating butterfly throttle located in the air passage posterior to the fuel orifice, a shaft for the throttle, an oscillating butterfly regulating valve located in the air passage anterior to the fuel orifice, a shaft for the regulating valve, the regulating valve at one side of the shaft being cut away to produce a partially unbalanced condition of the valve, a ledge being provided in the air passage to co-operate with the smaller side of the regulating valve, and spring means connecting the throttle and regulating valve shafts and arranged to apply varying resistance to opening movement of the regulating valve under the influence of entering air in different positions of the throttle and at different engine speeds.

5. A carburetor comprising a body having an air passage including a mixing space, a fuel conduit having an orifice in the mixing space, an oscillating butterfly throttle located in the air passage posterior to the fuel orifice, a shaft for the throttle, an oscillating butterfly regulating valve located in the air passage anterior to the fuel orifice, a shaft for the regulating valve, the regulat-

ing valve at one side of the shaft being cut away to produce a partially unbalanced condition of the valve, a ledge being provided in the air passage to co-operate with the smaller side of the regulating valve, an arm on the throttle shaft extending nearly at a right angle to the plane of the throttle, an arm on the regulator shaft extending nearly in the plane of the regulating valve, a link connecting the free ends of the arms and slidable in relation to one of them and a compression spring on the link acting in connection with the stated arm arrangement to oppose varying resistance to opening movement of the regulating valve in different throttle positions and at different engine speeds.

6. In a carburetor, a body providing an air passage, a fuel discharge orifice therein, a throttle, an automatic air regulating valve movably mounted in the air passage and arranged to be opened by movement of air through the air passage, and means connecting the throttle and the regulating valve and arranged in any given throttle position to oppose yielding resistance to opening movement of the valve with the resistance decreasing as air flow increases.

7. In a carburetor, a body providing an air passage, a fuel discharge orifice therein, a throttle, an automatic air regulating valve movably mounted in the air passage anterior to the throttle and arranged to be opened by movement of air through the air passage, and means connecting the throttle and the regulating valve and arranged to oppose yielding resistance to opening movement of the valve and also arranged so that with a given throttle setting the resistance to opening movement of the regulating valve decreases as the valve opens wider under the influence of increased flow of air.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

ALBERT E. HARTWELL.

Witnesses:

ETHEL JOHNES,

D. M. SMITH.