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A. E. HARTWELL

CARBURETOR

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Fig. 1.

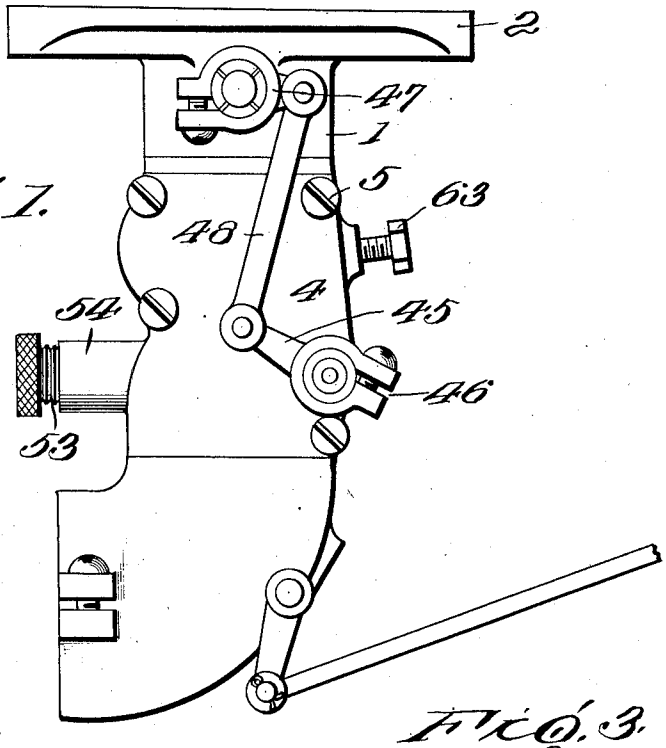


Fig. 2.

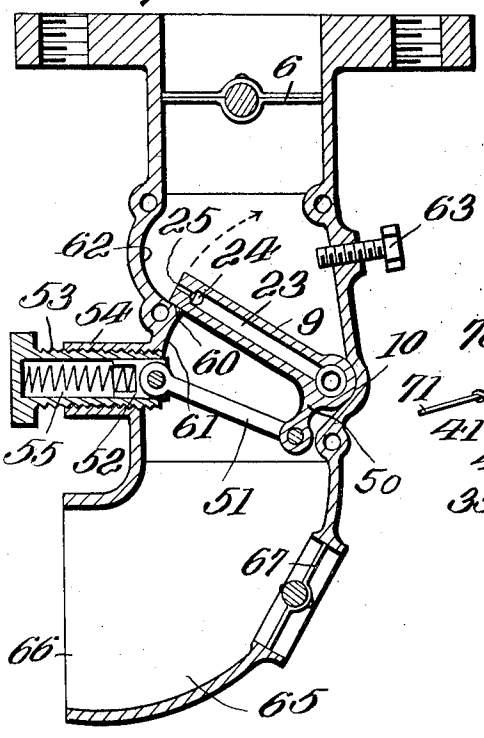
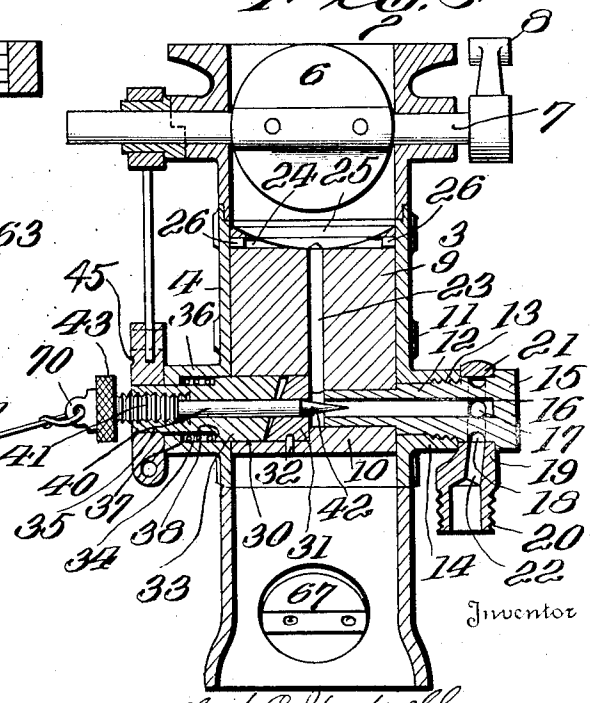


Fig. 3.



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UNITED STATES PATENT OFFICE.

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CARBURETOR.

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The general object of the invention is to provide a simple, durable and reasonably inexpensive instrument which proportions the fuel to the air with great accuracy under varying operative conditions. A more particular object is to provide means acted upon both by the throttle and by an element moved by the current of air passing through the instrument to regulate the fuel supply very accurately in accordance with the position of the throttle and the varying speeds of the engine for each of the throttle positions. Still more particularly an important object is to provide means for setting a fuel valve in accordance with the position of the throttle and for each of such valve settings to further vary the valve position in accordance with the movements of an element actuated by the air stream and consequently changing the fuel valve setting in accordance with the engine speed. A further object is to oppose a varying resistance to the air stream and at the same time to deliver the fuel at the point of substantially the greatest velocity of the air stream to insure the proper eduction and atomization of the fuel under all conditions and particularly at the lower engine speeds, and also to maintain a substantial pressure differential in the instrument at all times, and especially at the lower engine speeds, so that fuel may be drawn to the point of utilization in the instrument from a low down tank (when such a tank arrangement is desired) without the interposition of any fuel pump or other fuel feed device, and without a float chamber.

Other objects are realized in the mechanical embodiment of the invention as sufficiently explained hereinafter.

The accompanying drawing shows one representative embodiment of the invention. After considering this in connection with the description, persons skilled in the art will understand how the invention may be embodied in other forms.

Figure 1 is a side elevation of a carburetor embodying the invention.

Fig. 2 is a vertical section in a plane parallel to Fig. 1 and,

Fig. 3 is a vertical section in the transverse plane of Fig. 1, this view being somewhat diagrammatic, its plane for illustrative purposes being made to pass through the throat valve and fuel supply tube.

The body 1 has the usual flange 2 for attachment to the intake manifold. At two opposite sides the body is provided with openings and these openings are closed by side plates 3 and 4 attached by screws 5. The cross sectional shape of an intermediate part of the instrument is preferably substantially rectangular and the openings and cover plates permit the instrument to be properly formed in this shape and also permit the interior to be machined to the extent that is necessary or desirable.

The usual throttle 6 is located in an upper part of the instrument and this throttle is carried on a shaft 7. The usual lever arm 8 for connection to foot and hand controlling devices is mounted on one end of the shaft.

Below the throttle is a movable element 9 acting upon and actuated by the air stream. This element may for identification be called an air valve. It is usually of substantially rectangular outline and its sides fit with suitable closeness to the detachable side plates 3 and 4. The air valve is provided with a base enlargement or hub 10 having an aperture which provides an oscillating bearing for the valve upon the reduced inner end of fuel tube 12. This fuel tube has a screw thread 13 seated in an internal thread in a cylindrical boss 14 formed on side plate 3, and the tube also has an enlarged head 15 which may be in the form of a nut. The tube has a central bore 16, and lateral holes 17 are drilled through it near the head 15 to communicate with an annular channel 18 formed about the tube at this point. A connection for fuel from any suitable tank to the fuel tube is provided conveniently by a fitting 19 which has a part 20 adapted to receive any standard fuel line connection member, and also has a ring shaped part 21 surrounding the annular channel 18. The fitting has a passage 22 leading to the channel. In assembling the instrument the fuel tube is passed through the ring 21 of the fitting and then screwed into the boss 14. The fitting may be placed in any convenient position to receive the fuel line connection and then secured to make the fuel conduit fuel-tight by screwing the tube in firmly. The inner end of the fuel tube fits within the aperture in the valve hub.

Substantially centrally located in the

air valve is a passage 23 leading from the hub aperture to a point where the passage is intersected by a transverse channel 24 formed by drilling laterally through the valve near its free edge. The channel 24 is also intersected by a thin slot 25 which may be conveniently formed by means of a very thin circular saw or milling cutter. The ends of transverse channel 24 are closed by plugs 26. By the channels and slot just described, a fuel orifice extending entirely across the free edge of the air valve is formed in a simple way.

The portion 30 of the hub aperture of the air valve extending toward the side opposite from the fuel tube is of enlarged diameter. At the inner end of the enlarged portion 30 of the hub aperture is located a short cylindrical cam body 31 which is fixed in position to move with the air valve 9 by a pin 32. Revolubly mounted in aperture 30 and in line with the cam body 31 is another cylindrical cam body, or sleeve 33. The confronting annular faces of the cam body 31 and sleeve 33 are formed into cooperating cam surfaces, or in other words, these confronting faces of the two cylindrical bodies may be cut on an angle which will produce one suitable form of cam surfaces for the purpose in view. Relative rotary movement of the two cam bodies caused by their connection with the air valve 9 and with the throttle respectively, as later more particularly explained, will cause the cam sleeve or body 33 to move axially away from and back toward the cam body 31 and this relative movement controls the positioning of the fuel valve 40, as also later more particularly explained. The sleeve 33 is formed with a shoulder 34 from which a portion 35 of slightly reduced diameter extends outward. From the point where it extends out from the air valve sleeve 33 is accommodated in a cylindrical boss 36 of side plate 4. This boss is bored to provide a bearing for the larger part of sleeve 33 and is formed with an inwardly extending shoulder 37; and a light spring 38 is compressed between shoulder 34 of the sleeve and shoulder 37 of the boss and accommodated in the recess provided between the sleeve and the boss at this point. This spring serves to retain sleeve 33 in position with the cam faces on elements 31 and 33 abutting while permitting it to move in and out to adjust the fuel orifice as explained below. Sleeve 33 and cam 31 are bored through centrally and a needle valve 40, usually identified as the fuel valve, extends through this bore and is adjusted by means of a screw thread 41 engaging an internal thread formed in the outer part of the bore. The tapered inner end 42 of the needle valve constituting the fuel valve proper cooperates with the inner end of the fuel tube to regulate the amount of fuel permitted to pass from the tube to the fuel nozzle 25. The fuel valve has a knurled head 43.

An arm 45 is connected to the outer end of sleeve 33 usually by means of a split clamp 46. This clamp permits the angular position of the arm to be easily adjusted when desired. A similar arm 47, although usually shorter than arm 45, is secured on throttle shaft 7 at the same side of the instrument. These arms are connected by a link 48 which is preferably quite thin to permit a certain amount of lateral flexibility. The arms and link cause sleeve 33 and its cam to rotate in accordance with the movement of the throttle for reasons later described.

The hub 10 of air valve 9 is provided with an arm 50 which usually extends substantially at a right angle from the valve proper. This arm is connected by a link 51 with a slide or plunger 52 located in a hollow screw 53 which in turn is seated in a cylindrical boss 54 of the carburetor body. A spring 55 is located in the hollow screw and opposes the inward movement of the plunger. Tension of the spring is adjusted by turning screw 53.

The location and arrangement of the air valve may vary considerably and so also with regard to the interior parts of the carburetor body which cooperate with the valve to form the mixing space or part of the air channel adjacent to the fuel nozzle But in a preferred arrangement, as shown, the air valve usually lies, when closed, at a moderate angle above the horizontal and rests upon a part 60 of the carburetor body which may be identified in some cases as a "ledge", and preferably this ledge or stop for the outer end of the valve lies between a curved inner surface 61 of the air passage leading to the air valve and a curved inner surface 62 leading away from the valve, these surfaces being designed to direct the air current in natural lines of flow so far as possible. An adjustable stop 63 may be provided when necessary or desirable to limit the opening movement of the air valve.

The lower portion of the carburetor body may be provided with a bend 65 as shown, and the intake end 66 may be arranged to receive a hot air connection. A butterfly valve 67 may also be provided to admit an adjustable amount of cold air at some point below the mixing space.

It is frequently desirable to provide convenient means operable from the driver's position for retracting the fuel valve to admit an increased amount of fuel, for instance in starting. For this purpose the needle valve may be provided with an eye 70, and to this may be connected a flexible wire or cord 71 leading to the dash of the car in which the carburetor is installed, or to any

other suitable location. This cord is arranged to have normally a moderate amount of slack, and when so arranged does not interfere with the normal operation of the instrument. When the cord is pulled however the slack is taken up and the needle valve with its sleeve 33 are pulled out sufficiently to give an extra flow of fuel for starting priming.

In the position of parts shown in Fig. 2 the air passage is completely closed by the air valve which is held upon its ledge or seat 60 by spring 55 acting through link 51. The throttle is closed and through the link connection 48 sleeve 33 is held in such a position that its cam surface is so positioned in relation to cam 31 that the sleeve and needle valve are held in their innermost position by spring 38. The fuel valve 40 is adjusted to give the desired amount of fuel for idling. When it is desired to start the engine the throttle is opened more or less. This throttle movement acts through link 48 to rotate sleeve 33. Cam 31 is held still by its connection with the air valve. The cam surface on sleeve 33 acting on cam 31 causes the sleeve to move outward to an extent which has a certain ratio to the degree of throttle opening, and thus the fuel valve is opened wider to a corresponding extent. When the engine begins to rotate the air pressure above the air valve is reduced very materially before the valve begins to move. This creates a powerful suction at the fuel orifice and draws an ample supply of fuel for starting through the orifice, channel 23, the tube passage 16, and the fuel line. The reduction of pressure is ample to draw fuel properly from the rear tank of a vehicle even when it is located as far below the fuel nozzle as it is possible to locate such a tank in a motor vehicle. At this moment the spring 55 and its linkage are in position to exert the maximum degree of resistance to opening movement of the air valve. The described condition having persisted for an appreciable fraction of time, the air valve opens under the pressure of atmospheric air to an extent depending upon the amount of throttle opening and the speed of the engine. A constriction is thus formed between the edge of the air valve and shoulder 60 and the air column at this point has the highest velocity that it reaches anywhere in the instrument. This rapidly moving air jet passes smoothly around the curved surface 62 toward the throttle and in doing so is mixed with fuel issuing from the fuel outlet, this supply of fuel being distributed entirely across the air stream at a point immediately adjacent to the throat, or point of highest velocity. Spring 55 causes the air valve to maintain a resistance to the air, this resistance decreasing however in proportion to the amount of opening of the valve, since as the valve opens the arm 50 and link 51 come more nearly into line and have substantially a toggle action. This to a great extent overcomes the added resistance of the spring as it is compressed and also tends to reduce the resistance to the movement of air at the higher speeds, since at these speeds the volume and velocity of air are sufficient to educt the proper amount of fuel from the nozzle with a moderate amount of resistance of the air valve. As the air valve opens cam 31 rotates in relation to sleeve 33 which is now stationary, and the cam surfaces are brought back toward their normal relative position. In other words sleeve 33 is permitted to move inwardly under the impulse of its spring 38 and the fuel valve is closed to a proportionate extent, reducing the supply of fuel to the proper proportion corresponding to the speed of the engine and the amount of air passing through the throat as indicated by the position of the air valve. With the engine running under its own power, if the same throttle adjustment is maintained, the amount and speed of air passing through the instrument will vary in accordance with the speed of the engine, which in turn depends upon the load. The air valve will be correspondingly positioned by the air flow and in each of its positions the fuel cams 31 and 33 will position the fuel valve properly to deliver the proper proportion of fuel for the engine's speed.

In each opening movement of the throttle the fuel supply is increased ahead of the response by the air valve to the increased engine speed, assuming that the engine speeds up in proportion to the increased opening of the throttle. A richer proportion of fuel is thus supplied and the missing or slow acceleration of the engine which frequently occurs in ordinary practice due to failure to get sufficient fuel for the increased air supply as the throttle is opened wider, is avoided. As soon as the engine speeds up or the amount of air passing the valve increases to the normal amount for the throttle setting the air valve opens wider to a corresponding extent and the fuel supply is cut down by the interaction of the fuel cams 31 and 33 to the normal amount for that throttle setting and engine speed.

When the throttle is moved toward closed position the supply of fuel is reduced ahead of the closing movement of the air valve. This avoids flooding and choking frequently experienced in ordinary practice due to the continued flow of fuel under inertia when the throttle is quickly closed. As soon as the engine speed adjusts itself to the new condition the closing movement of the air valve reopens the fuel valve somewhat, so as to properly proportion the fuel for the new running condition.

When throttle arm 47 is considerably shorter than sleeve arm 45, as above described, and when the angular positions of the arms on their shaft and sleeve respectively are as shown in Fig. 1, that is with arm 47 substantially horizontal and arm 45 tilted upward at a substantial angle to horizontal when the throttle is in closed position, the first opening movement of the throttle moves the sleeve 33 and its cam through a considerable angle, but as the throttle opening movement is continued and the position of arm 47 approaches the vertical the relative movement of the sleeve and its cam are progressively less; that is, this arrangement provides for a varying relation of movement of cam sleeve 33 to the throttle movement. The increase in fuel supply provided by the opening of the throttle is relatively less as the throttle opening increases. To suit different operative conditions the interaction between the throttle and the fuel valve may be varied by adjusting the angular positions of arms 45 and 47.

The organization of the instrument is such that a sufficiently reduced pressure is maintained at the fuel nozzle at all times to draw fuel from a low tank and at the same time the interaction of the regulating elements is such as to prevent an excess supply of fuel at any of the different running points.

I claim:

1. In a carburetor, the combination of a body providing an air passage, a throttle, an air valve below the throttle acted upon by the air current, a fuel orifice discharging in the vicinity of the air valve, a fuel controlling valve, means acting upon opening movement of the throttle tending to open the fuel valve, and means acting upon opening movement of the air valve tending to close the fuel valve.

2. A carburetor for internal combustion engines, comprising a body providing an air passage, an air valve movably mounted in the passage and arranged for direct actuation by the air stream and to provide a varying aperture in accordance with the flow of air depending on variations in engine speed, a throttle, a fuel aperture in the air passage, a valve to control the supply of fuel to the aperture, a cam member connected to move with the air valve and a cooperating cam member connected to move with the throttle, the cam members acting upon the fuel valve to regulate the fuel opening in accordance with both the throttle position and the flow of air.

3. A carburetor for internal combustion engines, comprising a body providing an air passage, an air valve movably mounted in the passage and arranged for direct actuation by the air stream and to provide a varying aperture in accordance with the flow of air depending on variations in engine speed, a throttle, a fuel aperture in the movable air valve, a valve to control the supply of fuel to the aperture, a cam member connected to move with the air valve and a cooperating cam member connected to move with the throttle, the cam members acting upon the fuel valve to regulate the fuel opening in accordance with both the throttle position and the flow of air.

4. A carburetor for internal combustion engines, comprising a body providing an air passage, an air valve movably mounted in the passage and arranged for direct actuation by the air stream and to provide a varying aperture in accordance with the flow of air depending on variations in engine speed, means for opposing varying resistance to the opening movement of the air valve, the resistance decreasing as the valve opening increases, a throttle, a fuel aperture in the air passage, a valve to control the supply of fuel to the aperture, a cam member connected to move with the air valve and a cooperating cam member connected to move with the throttle, the cam members acting upon the fuel valve to regulate the fuel opening in accordance with both the throttle position and the flow of air.

5. In a carburetor, the combination of a body having an air passage, a throttle therein, an air actuated valve in the air passage and pivotally mounted near one side thereof, the air valve having a long narrow fuel orifice near its free edge and a fuel passage leading to the orifice, a fuel tube leading through the pivot axis of the valve to said passage, a fuel valve seat located in the fuel tube, a fuel valve co-operating with the seat, and means actuated by the co-operative movement of the air valve and throttle to position the fuel valve.

6. In a carburetor, the combination of a body providing an air passage, an oscillatable air valve, a fuel tube extending into and providing a bearing for the air valve, a cam fixed in the air valve coaxially with the fuel tube, a sleeve rotatably mounted in respect to the air valve and coaxial with the fuel tube, said sleeve having a cam surface to cooperate with said cam, a throttle above the air valve, a throttle shaft, an arm on said shaft, an arm on said sleeve, a link connecting the arms, and a fuel valve carried by the sleeve and arranged to cooperate with a valve-seat provided in the air valve.

7. In a carburetor, the combination of a body providing an air passage, an oscillatable air valve, a fuel tube extending into and providing a bearing for the air valve, a cam fixed in the air valve coaxially with the fuel tube, a sleeve rotatably mounted in respect to the air valve and coaxial with the fuel tube, said sleeve having a cam surface to cooperate with said cam, means retaining the sleeve yieldably in position, a throttle

above the air valve, a throttle shaft, an arm on said shaft, an arm on said sleeve, a link connecting the arms, and a fuel valve carried by the sleeve and arranged to cooperate with a valve-seat provided in the air valve.

8. In a carburetor, the combination of a body providing an air passage, an oscillatable air valve, a fuel tube extending into and providing a bearing for the air valve, a cam fixed in the air valve coaxially with the fuel tube, a sleeve rotatably mounted in respect to the air valve and coaxial with the fuel tube, said sleeve having a cam surface to cooperate with said cam, a throttle above the air valve, a throttle shaft, an arm on said shaft, an arm on said sleeve, a link connecting the arms, a fuel valve carried by the sleeve and arranged to cooperate with a valve-seat provided in the air valve, an arm extending from the air valve near its pivot axis, a plunger arranged to reciprocate toward and from the pivot axis, a spring resisting movement of the plunger, and a link connecting the plunger with said arm of the air valve.

9. In a carburetor, the combination of a body providing an air passage, an oscillatable air valve, a fuel tube extending into and providing a bearing for the air valve, a cam fixed in the air valve coaxially with the fuel tube, a sleeve rotatably mounted in respect to the air valve and coaxial with the fuel tube, said sleeve having a cam surface to cooperate with said cam, a throttle above the throat valve, a throttle shaft, an arm on said shaft, an arm on said sleeve, a link connecting the arms, a fuel valve carried by the sleeve and arranged to cooperate with a valve-seat provided in the air valve, the air valve being provided near its upper edge with a thin fuel orifice extending substantially the width of the valve, and a fuel passage leading from the orifice to a point of communication with the fuel orifice controlled by said fuel valve.

10. In a carburetor, the combination of a body providing an air passage, an oscillatable air valve, a fuel tube extending into and providing a bearing for the air valve, a cam fixed in the air valve coaxially with the fuel tube, a sleeve rotatably mounted in respect to the air valve and coaxial with the fuel tube, said sleeve having a cam surface to cooperate with said cam, a throttle above the air valve, a throttle shaft, an arm on said shaft, an arm on said sleeve, a link connecting the arms, a fuel valve carried by the sleeve and arranged to cooperate with a valve-seat provided in the air valve, the air passage being provided with a ledge to cooperate with the air valve, and with curved surfaces leading to and from the ledge.

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